CSI 9420 Wireless Vibration Transmitter

Reference Manual

EMERSON
Process Management

Read this manual before working with the product. For personal and system safety, and for optimum product performance, make sure to thoroughly understand the contents before installing, using, or maintaining this product.

If you need product support, contact:

Global Service Center (GSC)

Phone:	1-800-833-8314
	1-877-812-4036
Email:	*mhm.custserv@emerson.com*
Web:	*http://www.assetweb.com/mhm* and select Product Support

World Wide Customer Service

Phone:	1-888-367-3774 (Option 2 CSI)
Email:	wwcs.custserv@emerson.com

⚠ CAUTION!

The product described in this document are NOT designed for nuclear-qualified applications.

Using a non-nuclear qualified product in applications that require nuclear-qualified hardware or products may cause inaccurate readings.

The CSI 9420 Wireless Vibration Transmitter may be protected by one or more U.S. Patents pending. Other foreign patents pending.

⚠ WARNING!

Explosions could result in death or serious injury:

- **Installation of this transmitter in an explosive environment must be in accordance with the appropriate local, national, and international standards, codes, and practices. Please review the approvals section of this document for any restrictions associated with a safe installation.**
- **Before connecting a Field Communicator in an explosive atmosphere, ensure the instruments are installed in accordance with applicable field wiring practices.**

Electrical shock can result in death or serious injury. Avoid contact with the leads and terminals. High voltage that may be present on leads can cause electrical shock.

CE Notice

Emerson Process Management products bearing the symbol on the product or in the user's manual are in compliance with applicable EMC and Safety Directives of the European Union. In accordance with CENELEC standard EN 50082-2, normal intended operation is specified as follows: 1. The product must not pose a safety hazard. 2. The product must not sustain damage as a result of use under environmental conditions specified in the user documentation. 3. The product must stay in or default to an operating mode that is restorable by the user. 4. The product must not lose program memory, user-configured memory (e.g., routes), or previously stored data memory. When apparent, the user may need to initiate a reset and/or restart of a data acquisition in progress. A Declaration of Conformity certificate for the product is on file at the appropriate Emerson Process Management office within the European Community.

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Patents

The product(s) described in this manual are covered under existing and pending patents.

Contents

Appendices and reference

1 Introduction

Topics covered in this chapter:

- *Safety messages*
- *Overview*
- *Considerations*
- *Return of materials*

1.1 Safety messages

Instructions in this manual may require special precautions to ensure the safety of the personnel performing the operations.

Refer to the following safety messages before performing an operation preceded by the warning symbol.

⚠ WARNING!

Failure to follow these installation guidelines can result in death or serious injury.

Only qualified personnel should perform CSI 9420 installations.

Explosions could result in death or serious injury:

- **Before connecting a Field Communicator in an explosive environment, make sure the instruments are installed in accordance with applicable field wiring practices.**
- **Verify that the operating environment of the CSI 9420 is consistent with the appropriate hazardous locations certifications.**

Electrical shock can cause death or serious injury. Avoid contact with the leads and terminals. High voltage that may be present on leads can cause electrical shock.

This CSI 9420 device complies with Part 15 of the FCC Rules. Operation is subject to the following conditions: This device may not cause harmful interference, this device must accept any interference received, including interference that may cause undesired operation.

This device must be installed to ensure a minimum antenna separation of 20 cm from all persons.

1.2 Overview

The manual

This Reference Manual applies to the 2.4 GHz WirelessHART version of the CSI 9420 for use with the Smart Power Module unless otherwise specified. It is optimized for use with the most recent device and software revisions (AMS Suite: Machinery Health Manager v5.61 and AMS Suite: Intelligent Device Manager v12.5).

Use this manual to install, operate, and maintain the CSI 9420 Wireless Vibration Transmitter.

The transmitter

The CSI 9420 Wireless Vibration Transmitter is an installation-ready solution that monitors vibration and temperature in hard-to-reach locations. It also provides a variety of transmitter and sensor configurations.

Some of its features include:

- Support for up to 4 process variables with up to 3 user configurable alerts for each process variable
- Support for storage of Waveform/Spectrum directly in AMS Machinery Manager
- Wireless output with >99% data reliability, delivering rich HART data, protected by industry leading security (when operated as part of a well-formed network)
- Local operator interface with integral LCD that conveniently displays measured values and diagnostics
- Simple and easy installation, used today for robust installations

Device revision information

Revision	Current level	Description
Universal	7	This is the HART version the transmitter supports.
Field device[1]	4	This is the major revision of the transmitter and corresponds with a major interface release. When using AMS Device Manager, this revision can be found on the screen title. 
Software	6	This is the current software version. The software may be occasionally modified to refine functionality. When major functionality is added, the device revision increases.
Hardware	5	This is the hardware revision.
DD	1	This is the Device Descriptor (DD) revision. The device descriptor is primarily used for configuring devices in the field.

(1) *If you have an older device revision, a factory upgrade may be possible in some cases. Contact Product Support for more information.*

You can view the revision information in a Field Communicator and in AMS Device Manager.

Figure 1-1: Revision numbers in a 475 Field Communicator

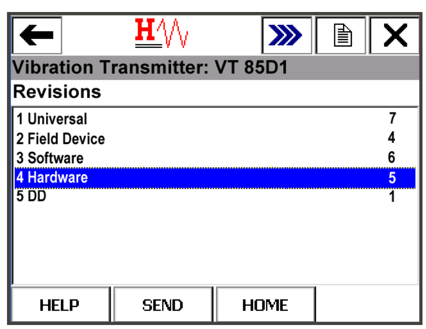
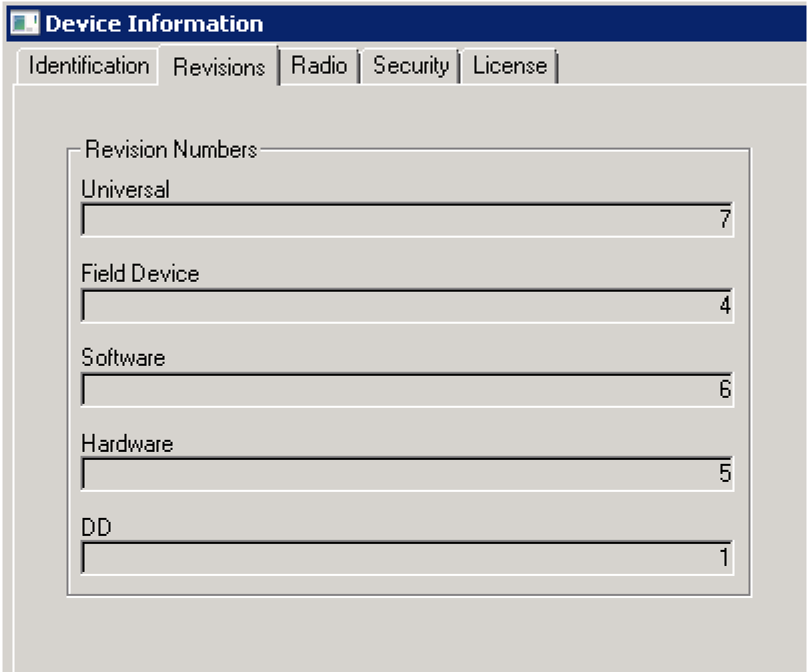


Figure 1-2: Revision numbers in AMS Device Manager



1.3 Considerations

General

Electrical vibration sensors, such as accelerometers, produce low-level signals proportional to their sensed vibration. With simple HART configuration, the transmitter converts the low-level sensor signal to a wireless-enabled signal.

Commissioning

The transmitter can be commissioned before or after installation. You can commission it on the bench before installation to ensure proper operation and to be familiar with its functions.

Make sure the instruments are installed in accordance with applicable field wiring practices.

The CSI 9420 device is powered whenever the power module is installed. To avoid depleting the power module, remove it when the device is not in use.

Installation

When choosing an installation location and position, provide ample access to the transmitter. For best performance, the antenna should be vertical, with some space between objects in a parallel metal plane such as a pipe or metal framework. Pipes or framework may adversely affect the performance of the antenna.

Electrical

Smart Power Module

The power module contains two “C” size primary lithium/thionyl chloride batteries. Each power module contains approximately 2.5 grams of lithium, for a total of 5 grams in each pack. Under normal conditions, the power module materials are self-contained and are not reactive as long as the batteries and the power module pack integrity is maintained. Take care to prevent thermal, electrical, or mechanical damage and protect contacts to prevent premature discharge.

⚠ CAUTION!

Use caution when handling the power module. The power module may be damaged if dropped from heights in excess of 20 feet.

External DC line power

Certain versions of the CSI 9420 are available for connecting to an external 10-28 VDC power source. This is used in place of the power module.

⚠ WARNING!

The CSI 9420 may not carry the same hazardous area ratings when operated with external DC line power.

Sensor

Make sensor connections through the cable entry at the side of the connection head. Provide adequate clearance for cover removal.

Environmental

The transmitter operates within specifications for ambient temperatures between –40°F and 185°F (–40°C and 85°C).

Verify that the operating environment of the transmitter is consistent with the appropriate hazardous location certifications.

1.4 Return of materials

You may need to ship the CSI 9420 to an Emerson Product Service Center for return or maintenance. Before shipping, contact Emerson Product Support to obtain a Return Materials Authorization (RMA) number and receive additional instructions.

Emerson Product Support contact information:

Global Service Center (GSC)

Phone:	1-800-833-8314
	1-877-812-4036
Email:	*mhm.custserv@emerson.com*
Web:	*http://www.assetweb.com/mhm* and select Product Support

World Wide Customer Service (WWCS)

Phone:	1-888-367-3774 (Option 2 CSI)
Email:	*wwcs.custserv@emerson.com*

Note

If the transmitter has been exposed to hazardous substances, a Material Safety Data Sheet (MSDS) must be included with the returned materials. An MSDS is required by law to be available to people exposed to specific hazardous substances.

2 Configuration

Topics covered in this chapter:

2.1 Configuration overview

You can configure the CSI 9420 either prior to installation or after the device is installed at the measurement location. You do not need to physically install or connect to the transmitter to complete the configuration. The transmitter, however, reports an alert until the sensor is connected; this is the expected behavior.

Note
The specific user interface for performing the configuration varies depending on the host used.

Procedure

1. **Connect to a wired HART interface**.

   Skip this step if your CSI 9420 is purchased pre-configured from the factory.
2. **Set the wireless network credentials (Network ID and Join Key) using wired connection.**

   Perform this step for the device to join a wireless network. After the device has joined, you can complete the rest of the steps over a wireless link.
3. ***(Optional)* Name the device (Tag and Device Description).**

   By default, the tag is VT xxxx, where xxxx is the unique radio ID on the wireless network. The device joins the network and operates correctly even if no changes are made, but it is usually preferable to name the device something meaningful for the specific application.
4. **Specify the type of sensor installed (for example: 1 accelerometer, 1 accelerometer with temperature, or 2 accelerometers) and name the sensor.**

   The factory default configuration is one accelerometer named SENSOR 1. Complete this step for different configurations and name the sensor something meaningful for the specific application.
5. **Enter the sensor sensitivity.**

   For improved accuracy, replace the nominal sensitivity value of 25 mV per g (2.55 mV per m/s^2) (default) with the value corresponding to your specific sensor.

6. **Specify the units (English, metric, or SI) that will be used for each parameter.**

   By default, units are set to English, unless the device is shipped to Japan.

7. **Specify which measurements (velocity, temperature, etc.) correspond to the process variables PV, SV, TV, and QV.**

   By default, PV is the Overall Velocity on sensor 1, SV is the PeakVue measurement on sensor 1, TV is the sensor 1 bias voltage, and QV is the supply voltage.

8. **Specify alert levels.**

   Determine the thresholds at which measurement alerts will display and determine the behavior of device alerts.

9. **Specify how the parameters will be published (optimized mode or generic mode).**

   By default, the device is configured to use generic mode as it provides the most consistent overall performance.

10. **Specify how often the parameters are published (update rate).**

    The default update rate is once every 60 minutes. A faster update rate is not recommended, unless the device is powered by an external power source, as it significantly reduces the power module life.

11. **Optimize for power consumption.**

    Reduce the publish rate and set the LCD mode to Off to minimize power consumption. As an additional step, you can configure the PowerSave mode settings to extend the power module life.

12. **Configure trending of parameters.**

    You can trend parameters in multiple locations such as in a plant historian, in AMS Machinery Manager, and in a DCS control system.

13. **If the device configuration will not be managed by a HART DCS (such as DeltaV), specify whether AMS Machinery Manager can make configuration changes.**

    By default, the device is set for a DCS to manage the configuration, and changes from AMS Machinery Manager are not permitted. You can, however, allow AMS Machinery Manager to make configuration changes by enabling MHM Access Control from AMS Device Manager or from a Field Communicator.

14. **If the device is licensed for the Advanced Diagnostics application (spectral data retrieval), configure storage of energy bands, spectra, and waveforms in the AMS Machinery Manager database.**

    With the Advanced Diagnostics application, you can collect data on-demand, automatically at periodic intervals, or on alert. Store on Alert is the recommended operating mode.

2.1.1 Connect to a wired HART interface

Unless the CSI 9420 is purchased pre-configured from the factory, you must connect it to a wired HART interface. This is to define device credentials that allow the device to communicate on your wireless network. You can also define other device configurations such as sensor type and alert thresholds at this time.

Notes

- Use the wired HART interface only for configuration. Dynamic variables (such as measured vibration parameters) are not updated when communicating on the wired interface.
- The CSI 9420 does not communicate simultaneously on both the wired and wireless HART interfaces. You will lose wireless connectivity when you connect to the wired HART interface. Configuration changes are not reflected in a wireless host until connection has been re-established. To avoid loss of synchronization, disconnect hosts relying on the wireless link when communicating with the device on the wired interface.

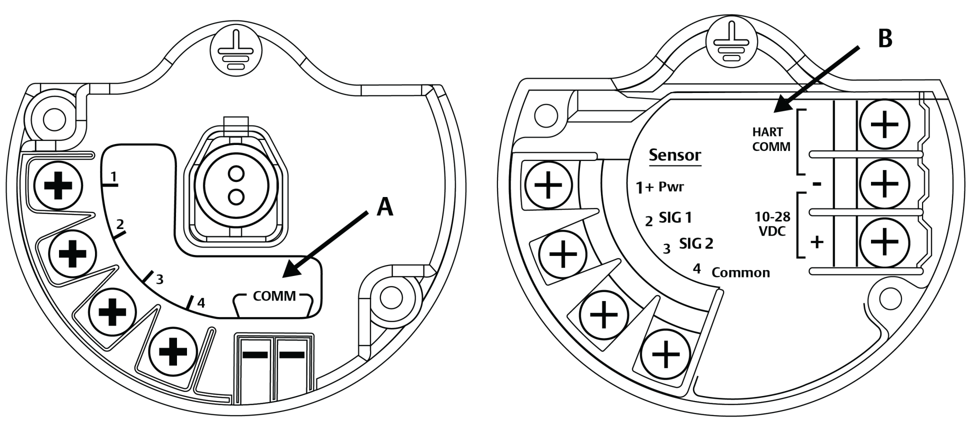
  For example, if you are viewing a configuration screen in AMS Device Manager through a wireless link, and you leave this screen open while making changes with a Field Communicator, you will have to exit AMS Device Manager and then re-open it (or re-scan the device) after the wireless connection has been restored in order to see the changes.

Procedure

1. Remove the transmitter back cover.

   This exposes the terminal block and HART communication terminals.

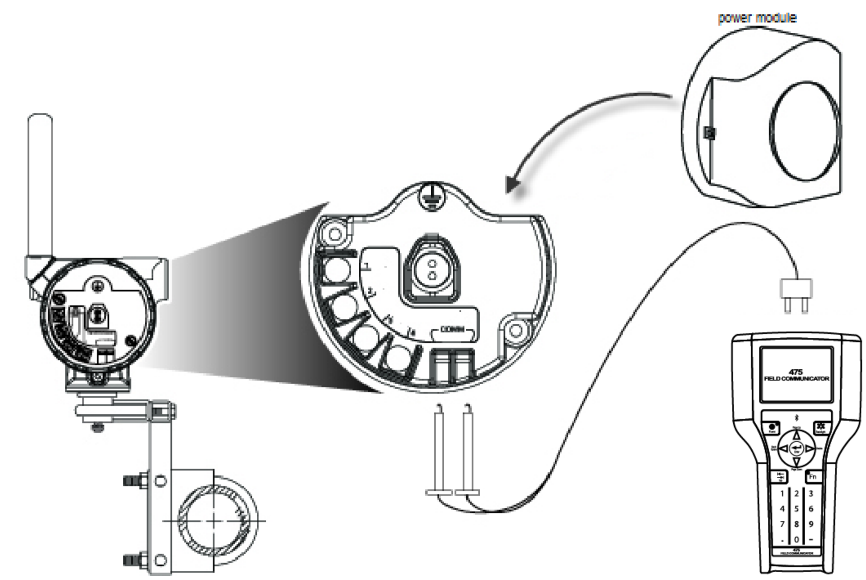
Figure 2-1: CSI 9420 terminal block with two-wire, polarity-independent connection



A. COMM terminals (power module version)
B. HART COMM terminals (externally powered version)

2. Connect the power module or supply power using an external power source.

Figure 2-2: Field Communicator and power module connection



3. Configure using a Field Communicator, AMS Device Manager, or any HART-enabled host.

   Press Send to send configuration changes to the transmitter.

   The CSI 9420 enters "HART Listen" mode for communication on the wired interface. HART Listen is displayed on the optional LCD, if it is installed.

   If the device is unable to enter the HART Listen mode during its boot sequence or while performing its real-time vibration measurement, retry the initial wired HART handshaking sequence.

   If repeated attempts to establish wired communication fail, you can force the device into a HART Listen mode by removing the transmitter front cover and pressing the CONFIG button once. Once the device enters HART Listen mode, it remains in this mode until you press the CONFIG button, the power cycles, or no activity is seen on the wired interface for three minutes. Pressing the CONFIG button a second time causes the device to exit HART Listen mode.

⚠ CAUTION!

The front electronics end cap (the cap covering the LCD) is certified for Class I, Division I in appropriate gas environments (check the nameplate on the device for details).

Exposing the electronics to a production environment can allow particulates, moisture, and other airborne chemicals to enter into the device, which could lead to contamination and potential product performance issues. In all cases, whenever opening the front end cap, be sure to seal it completely afterwards by tightening until the black O-ring is no longer visible. For an illustration on how to properly seal the end cap, see *Figure 3-12*.

4. When configuration is complete over the wired HART interface, disconnect the transmitter from the communication wires to re-establish wireless communication.

   This may take several minutes.

2.1.2 Set the wireless network configuration

This enables the transmitter to communicate with the Smart Wireless Gateway and with other systems. This is the wireless equivalent of connecting wires from a transmitter to a control system input.

Procedure

1. From the Smart Wireless Gateway, click Setup > Network > Settings to obtain the Network ID and Join Key.
2. Using a Field Communicator or AMS Device Manager with a wired modem, enter the Network ID and Join Key so that they match the Network ID and Join Key from the Smart Wireless Gateway.

Note

If the Network ID and Join Key are not identical to the gateway settings, the CSI 9420 will not communicate with the network.

2.1.3 Configuration options

The CSI 9420 configuration options control the following operations:

- How measurement results are reported and how often are they reported
- The number and type of sensors installed
- How and when alerts are generated

Table 2-1 shows the default device configuration. You can change these configurations from AMS Device Manager or from a Field Communicator.

Table 2-1: Default device configuration

Configuration option	Default value
Publishing mode	Generic
Update rate	60 minutes
PowerSave mode	PowerSave Skip Multiplier of 1X
LCD mode	Off
Power source	Power module/battery
MHM Access Control	Disabled
Write Protect	No
Sensor Configuration	
Sensor type	1 Accelerometer (sensor 2 not installed)
Sensor sensitivity	25 m V/g
Velocity Fmax	1000 Hz
PeakVue true Fmax	1000 Hz
Velocity spectrum lines of resolution	400 lines
PeakVue spectrum lines of resolution	1600 lines
Units	English Overall velocity: in/s RMS PeakVue: g's Temperature: °C
Variable mappings	
PV	Overall velocity, sensor 1
SV	PeakVue, sensor 1
TV	Bias, sensor 1
QV	Supply voltage

2.1.4 Sensor configuration

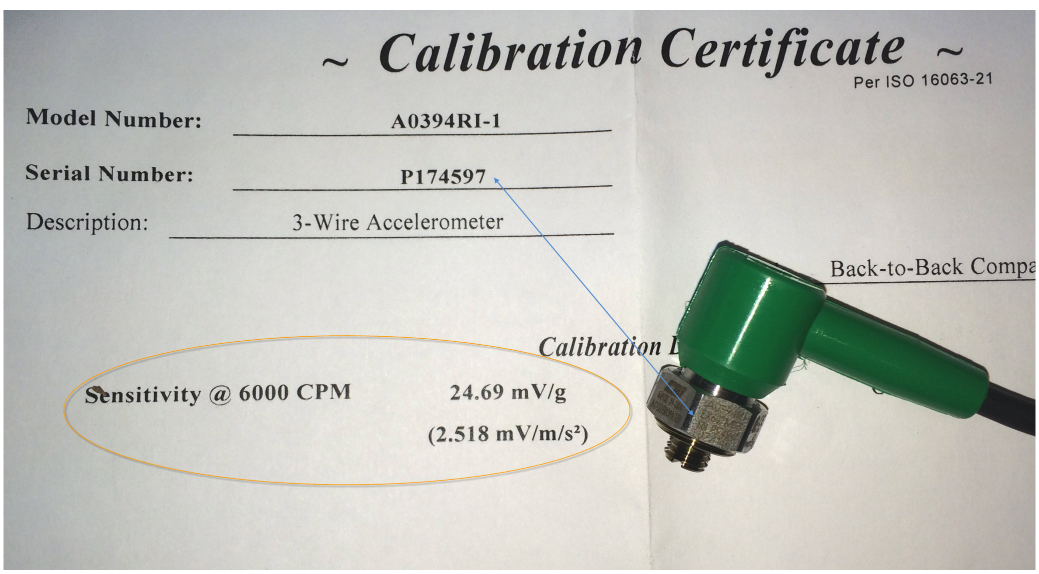
The CSI 9420 can be installed with two accelerometers, or with one accelerometer with an embedded temperature sensor. Table 2-2 shows the possible sensor configurations and variable mappings.

Table 2-2: Possible sensor configurations and variable mappings

Dynamic process variables	Available process variables based on sensor configuration		
	Sensor 1: Accelerometer Sensor 2: Not Installed	Sensor 1 and 2: Accelerometer with Temperature	Sensor 1: Accelerometer Sensor 2: Accelerometer
PV	Overall Velocity Sensor 1	Overall Velocity Sensor 1	Overall Velocity Sensor 1
SV	PeakVue Sensor 1	PeakVue Sensor 1	PeakVue Sensor 1
TV	Bias Sensor 1	Sensor Temperature	Overall Velocity Sensor 2
QV	Supply Voltage	Supply Voltage	PeakVue Sensor 2
Unmapped device variables	Ambient Temperature	Ambient Temperature Bias Sensor 1	Bias Sensor 1 Bias Sensor 2 Ambient Temperature Supply Voltage

Each sensor is characterized at the factory to determine the precise sensitivity. This information is included with the sensor, in the form of a certificate, and may be cross-referenced with the serial number as shown in Figure 2-3.

Figure 2-3: Calibration certificate



2.1.5 Measurement parameter units

Table 2-3 shows the measurement parameters and available units that can be configured for each parameter.

Table 2-3: Measurement parameter units

Parameter	Units
Velocity (Overall 1, Overall 2)	mm/s RMS in/s RMS
PeakVue maximum value (PeakVue 1, PeakVue 2)	m/s^2 g's
Temperature (Temperature 1, Ambient)	°C °F
Sensor Bias (Bias 1, Bias 2)	V
Supply Voltage	V

2.1.6 Alert levels

The CSI 9420 sets HART status bits to indicate when measured values exceed the configured thresholds. Each measured value has three levels: Advisory, Maintenance, and Failed that can be set independently. These thresholds are pre-configured at the factory to reasonable generic values for single-stage, electric motor-driven equipment trains operating at 1200–3600 RPM.

The level at which these thresholds should be set depends on the type of equipment being monitored and on your specific process.

One rule of thumb for vibration is to examine the current level at which the equipment is operating. Assuming the equipment is in good working condition, set the Advisory level at 2x the current value (or at a minimum of 0.05 in/s RMS, whichever is greater), set the Maintenance level at 4x the current value, and set the Failed level at 8x the current value. For example, if the current value for Overall Velocity is 0.1 in/s, set the Advisory threshold at 0.2 in/s, the Maintenance threshold at 0.4 in/s and the Failed threshold at 0.8 in/s. While this type of vibration program is not recommended, it can provide a starting point when no other information is available.

Table 2-4: Default alert thresholds for vibration

Alert limits	Advise		Maintenance		Failed	
	Default value	Report notification	Default value	Report notification	Default value	Report notification
Overall velocity (sensor 1, 2)	0.14 in/sec 3.556 mm/s	Yes	0.35 in/sec 8.89 mm/s	Yes	1 in/sec 25.4 mm/s	Yes
PeakVue (sensor 1, 2)	6 g's 58.8399 m/s^2	Yes	10 g's 98.0665 m/s^2	Yes	15 g's 147.09975 m/s^2	Yes

Table 2-4: Default alert thresholds for vibration *(continued)*

Alert limits	Advise		Maintenance		Failed	
	Default value	Report notification	Default value	Report notification	Default value	Report notification
Sensor temperature	65°C 149°F	Yes	75°C 167°F	Yes	85°C 185°F	Yes
Bias (sensor 1, 2)	–	–	–	–	Above: >3V Below: <2V	Yes*
Ambient temperature	–	–	–	–	Above: 85°C (185°F)* Below: -40°C (-40°F)*	Yes*
Supply voltage	<6.0 V	No	<5.7 V	Yes	<5.3 V*	Yes
**These are read-only parameters and cannot be modified.*						

A good rule of thumb for establishing the PeakVue alert levels is to use the rule of 10's. This applies for most rolling element bearing equipment with a turning speed between 900 and 4000 CPM. Using this approach, the Advisory alert would be set at 10 g's, the Maintenance alert at 20 g's, and the Failed alert at 40 g's. In general, PeakVue alert levels can then be interpreted as follows:

10 g's	Indication of Abnormal Situation
20 g's	Serious Abnormal Situation - Maintenance Plan Required
40 g's	Critical Abnormal Situation - Implement Maintenance Plan

For more information on PeakVue, see *Section 5.2*.

The default alert thresholds for temperature correspond closely to a generic open drip-proof (ODP) motor with class F insulation and a service factor of 1.15, operating at an ambient temperature of 40°C or below and at an altitude of 1000 meters or below . These values are also reasonable thresholds to use when there is no knowledge of the process, the type of machinery, or the operating environment. For more information, see *Chapter 5*.

Table 2-5: Default alert thresholds for temperature

Parameter	Advisory		Maintenance		Failed	
	Level	Enabled	Level	Enabled	Level	Enabled
Temperature	149°F (65°C)	Yes	167°F (75°C)	Yes	185°F (85°C)	Yes

The configurable device alerts include accelerometer bias and supply voltage. The default settings for these alerts are shown in *Table 2-6*.

Table 2-6: Default levels for configurable device alerts

Parameter	Advisory		Maintenance		Failed	
	Level	Enabled	Level	Enabled	Level	Enabled
Accelerometer Bias	N/A	N/A	N/A	N/A	< 2 V or > 3 V	Yes
Supply Voltage	< 6.0 V	No	< 5.7 V	Yes	< 5.3 V	Yes

Notes

- The supply voltage measurement is made under load conditions. The supply voltage may read differently with the CSI 9420 versus other Emerson transmitters or multimeters.
- Prior to sensor connection, it is normal to see alerts related to bias failure. These alerts go away when the sensor is installed correctly.
- When any measured process parameter (Velocity, PeakVue, or Temperature) exceeds the configured Advisory, Maintenance, or Failed threshold, this causes an "Advisory" indication that you can view from AMS Device Manager (or in another graphical host). This indicator itself does not set a status bit.

2.1.7 Publishing mode

The CSI 9420 can publish in either of two modes: optimized or generic (default).

Optimized mode uses less power by combining a large amount of information into a single command. In this mode, only the four standard process variables (PV, SV, TV, and QV) are published at the specified update interval and cached in the Smart Wireless Gateway. When values are cached in the gateway, it is not necessary to wake the device for the host system to be able to read the variables. The other variables are still available, but any request to read one of them wakes the device and consumes power.

Generic mode publishes all the process variables the device can produce. This mode requires three publish messages, which requires approximately 5% more power.

If you are only trending measurements mapped to PV, SV, TV, and QV, use optimized mode. If you are trending additional variables, use generic mode.

2.1.8 Update rate

The default update rate is 60 minutes. This is the maximum (fastest) recommended update rate. You can change this at commissioning or at any time through AMS Device Manager, a Field Communicator, or the Smart Wireless gateway web server. You can set the update rate from 1 minute to 1 hour.

Note

If the device uses a power module, and is configured to publish at the fastest allowable update rate (once per minute), the power module is expected to last only about 2-3 months.
For faster update rates, if your application allows it, use an external DC power option.

2.1.9 Minimize power consumption

The primary way to minimize power consumption is to reduce the publish rate.

Two other configuration settings that affect power consumption are:

- LCD (Liquid Crystal Display)
- PowerSave mode

LCD

Disable the LCD after installation is complete if it is not required during normal operation. It is neither necessary nor sufficient to physically remove the LCD; it must be disabled through configuration in order to save power. From AMS Device Manager, select the wireless network where the transmitter is connected, right-click the transmitter and select Configure > Manual Setup > General Settings tab > LCD Mode > Off.

Note

Disabling the LCD (not removing it, just disabling it) through configuration provides power savings of about 15–20%.

Leave the LCD installed even if it is disabled to provide valuable diagnostic information. To view the LCD, remove the front cover and press the DIAG button. This wakes the device and displays current information. This can be beneficial for taking a quick reading and to aid in troubleshooting.

⚠ CAUTION!

The front electronics end cap (the cap covering the LCD) is certified for Class I, Division I in appropriate gas environments (check the nameplate on the device for details).

Exposing the electronics to a production environment can allow particulates, moisture, and other airborne chemicals to enter into the device, which could lead to contamination and potential product performance issues. In all cases, whenever opening the front end cap, be sure to seal it completely afterwards by tightening until the black O-ring is no longer visible. For an illustration on how to properly seal the end cap, see *Figure 3-12*.

PowerSave mode

PowerSave mode is available in CSI 9420 devices that are Rev. 3 or later and it enables the device to make measurements less frequently, thereby conserving power. This is ideal when either power module life is more critical than the acquisition rate or when changes in vibration are only expected to occur over extended periods of time.

You can configure the settings for the PowerSave mode in AMS Machinery Manager (MHM Access Control must first be enabled) and in AMS Device Manager. The specific field is referred to as PowerSave Skip Multiplier. It is the number of times the transmitter skips data acquisitions between updates to the gateway.

At any point, the effective acquisition rate for the CSI 9420 is defined as:

Effective Acquisition Rate = (Update Rate) x (PowerSave Skip Multiplier)

Valid settings for the PowerSave Skip Multiplier range from 1X to 24X. In order to extend power module life, it should only be combined with a long update rate such as 60 minutes (54 minutes may be optimal for older versions of the CSI 9420). When this value is set to 1X, the CSI 9420 acquires a new reading at the update rate. A PowerSave Skip Multiplier of 2X combined with a 60-minute update rate results in a new acquisition every 120 minutes (every two hours). Similarly, a PowerSave Skip Multiplier of 24X with a 60-minute update rate results in a new acquisition every 1440 minutes (once per day).

2.1.10 Trend parameters

You can trend parameters in multiple locations such as in a plant historian or in AMS Machinery Manager. The method for configuring this functionality is contained in the associated software and the details of all the possibilities are beyond the scope of this manual. This manual only indicates some of the general capabilities and version requirements.

You can trend values in essentially any host that accepts Modbus or OPC inputs. Configure OPC tags and Modbus registers for wireless devices in the Smart Wireless Gateway web interface. Refer to the Smart Wireless Gateway User Manual for additional information. The settings in the gateway and the host must be consistent and entered in both locations (for example, Modbus register definitions).

DeltaV integrates native wireless I/O devices on the control network. Refer to the DeltaV documentation for more information on the required version. You can manage wireless devices as native HART devices, and trend variables accordingly. This type of installation also allows richer alerting and diagnostics because the full HART capabilities are available.

Ovation 3.3 or later also integrates the Smart Wireless Gateway with all the associated benefits of HART.

AMS Machinery Manager 5.4 or later supports HART functionality to read configuration and alert information, as well as the dynamic parameters from the CSI 9420. This allows AMS Machinery Manager to auto-discover all of the devices on the wireless mesh as well as the specific sensor configurations, units settings, and variable mappings for CSI 9420 devices.

Also, with AMS Machinery Manager and CSI 9420 devices (that are licensed for the Advanced Diagnostics application), you can trend Energy Band parameters. For more information, see *Section 2.4.1*.

DeltaV versions prior to 10.3 and Ovation versions prior to 3.3, though not integrated through HART, accept Modbus values from the wireless devices. DeltaV also accepts OPC values.

2.1.11 Remove the power module

The CSI 9420 device is powered whenever the power module is installed. To avoid depleting the power module, remove it when the device is not in use.

After you have configured the sensors and network, disconnect the communication leads, remove the power module (if the device is not already installed), and replace the transmitter cover. You should insert the power module only when you are ready to commission the device.

2.2 Configuration with a Field Communicator

You can configure the CSI 9420 using a Field Communicator. Follow the connection diagram in *Figure 2-2*.

A Rev 4 DD is recommended when using a Field Communicator to configure the CSI 9420. The DD for the CSI 9420 is located on the DVD that came with the transmitter. Refer to the Field Communicator User's Manual for more details on DDs or go to http://www2.emersonprocess.com/en-us/brands/Field-Communicator/Pages/SysSoftDDs.aspx for instructions on adding a DD for CSI 9420.

The CSI 9420 requires Field Communicator System Software version 3.2 or later.

Figure 2-4 through Figure 2-15 show the Field Communicator configuration menu trees for CSI 9420 using a Rev 4 DD. For ease of operation, you can access some common tasks in several locations of the menu structure.

Figure 2-4: Field Communicator menu tree for CSI 9420, one accelerometer: 1 of 4

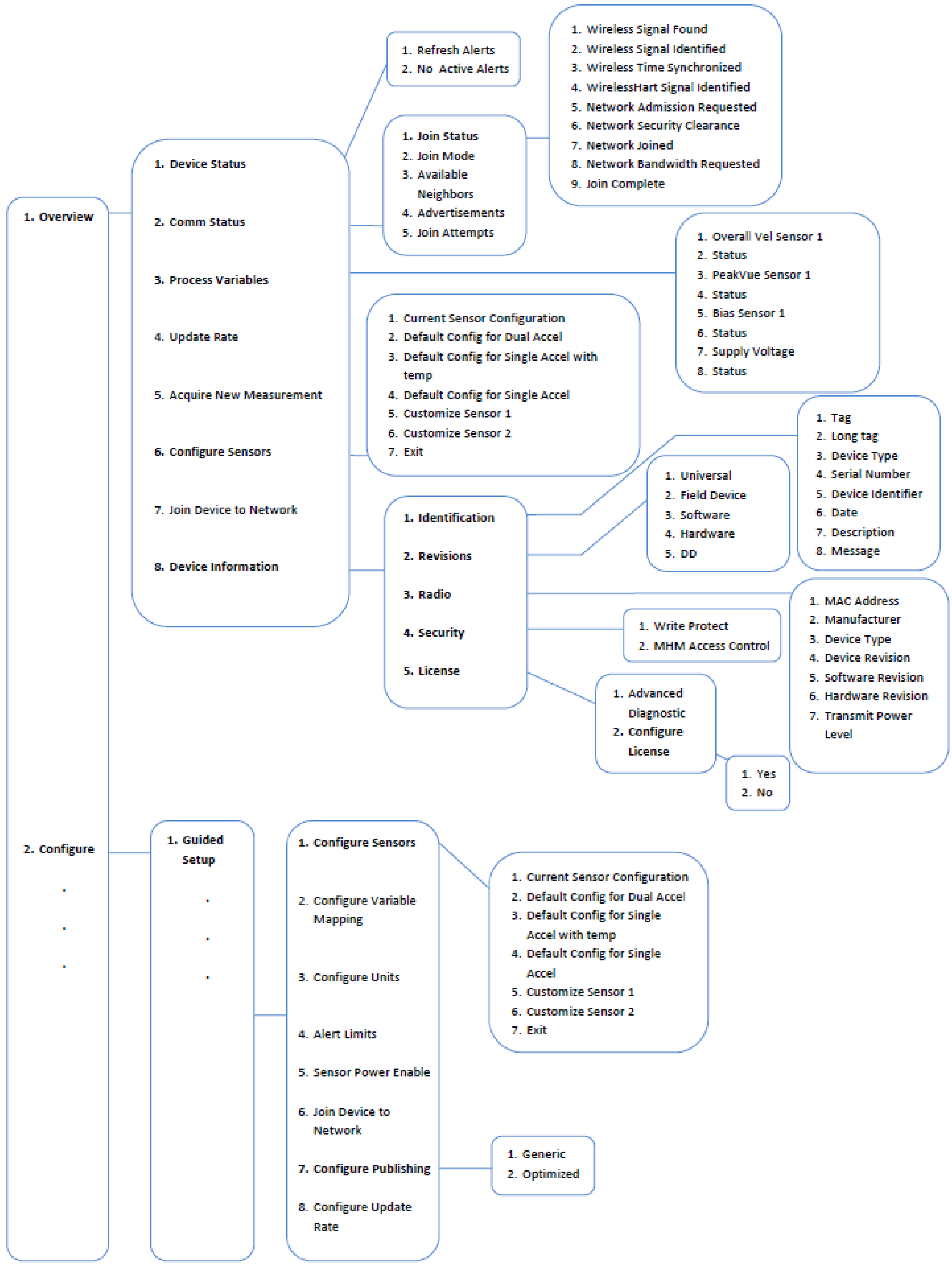


Figure 2-5: Field Communicator menu tree for CSI 9420, one accelerometer: 2 of 4

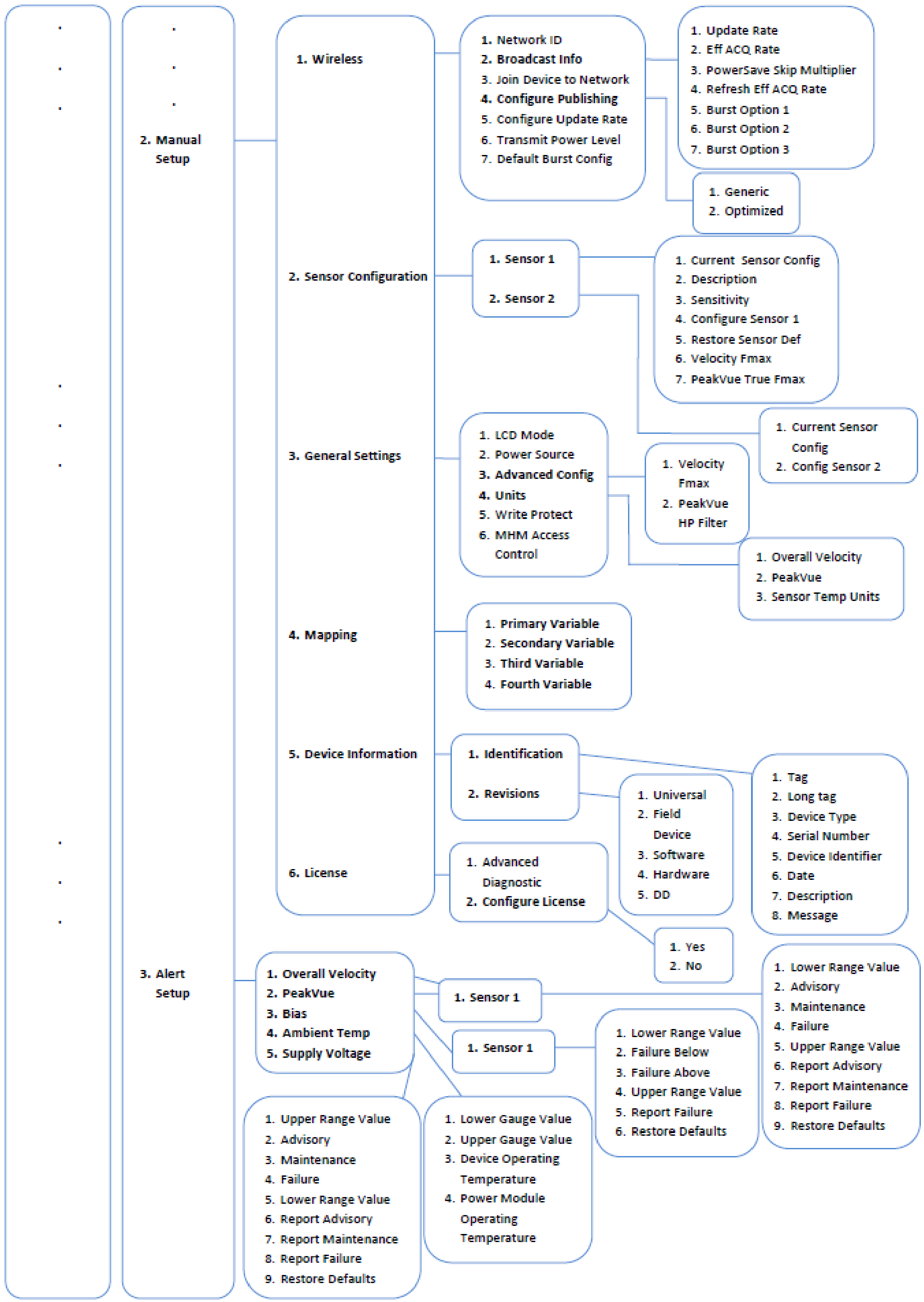
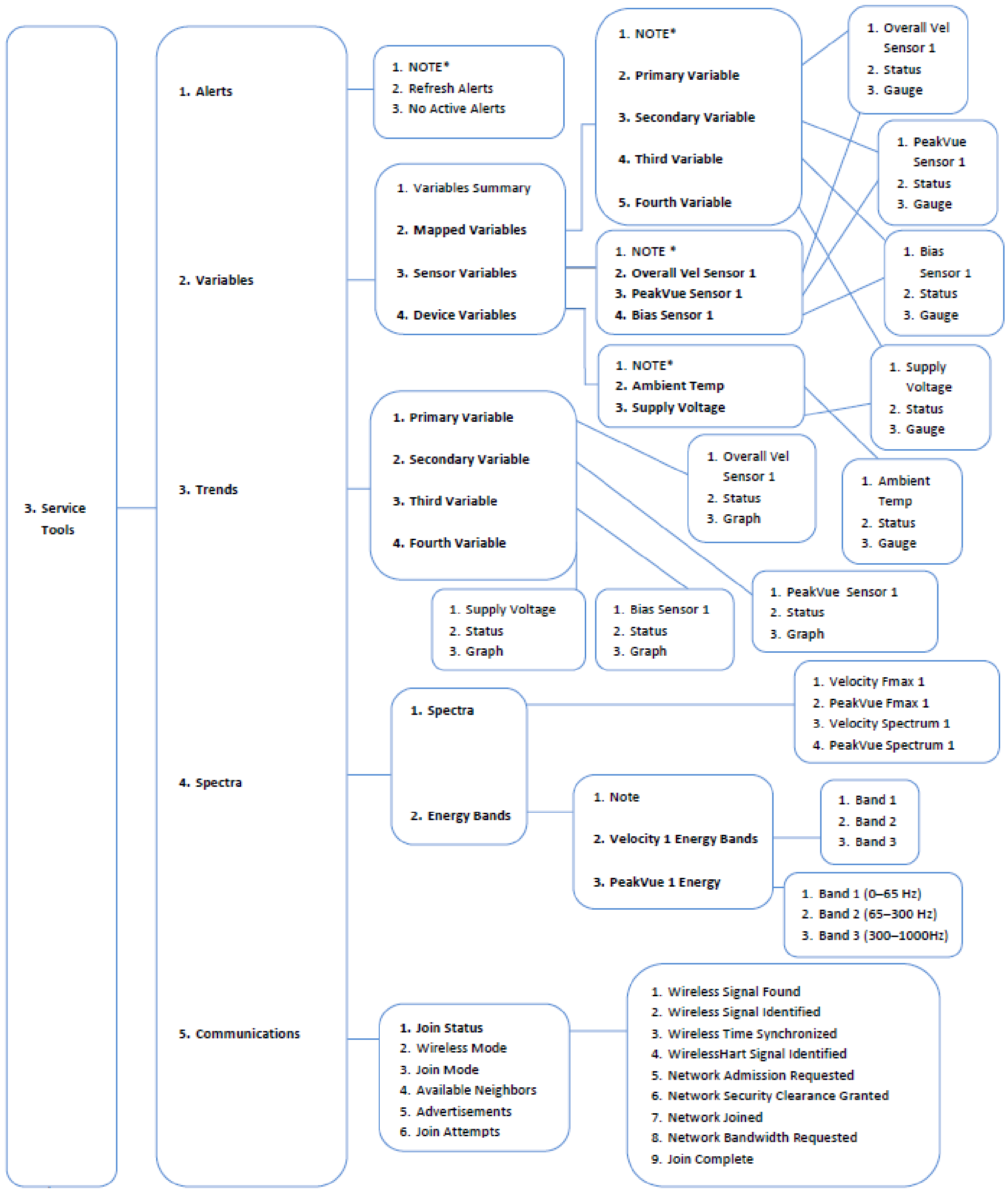


Figure 2-6: Field Communicator menu tree for CSI 9420, one accelerometer: 3 of 4



**This is only displayed when the device is configured to use the optimized burst mode.*

Figure 2-7: Field Communicator menu tree for CSI 9420, one accelerometer: 4 of 4

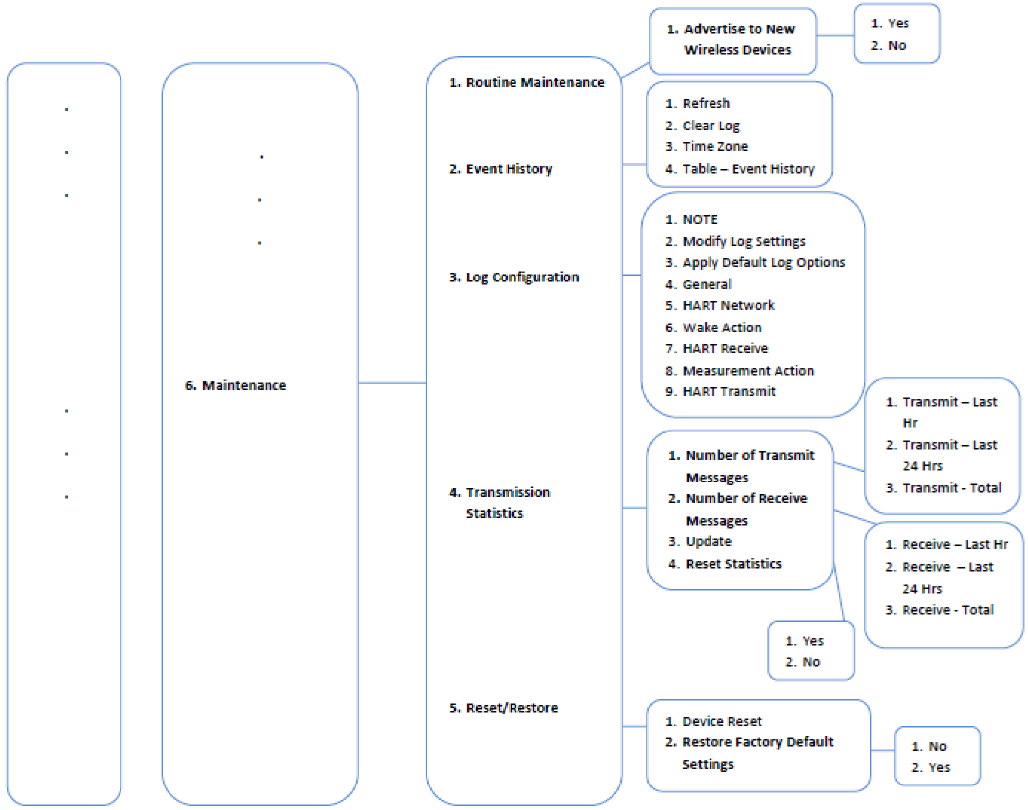


Figure 2-8: Field Communicator menu tree for CSI 9420, one accelerometer with temperature: 1 of 4

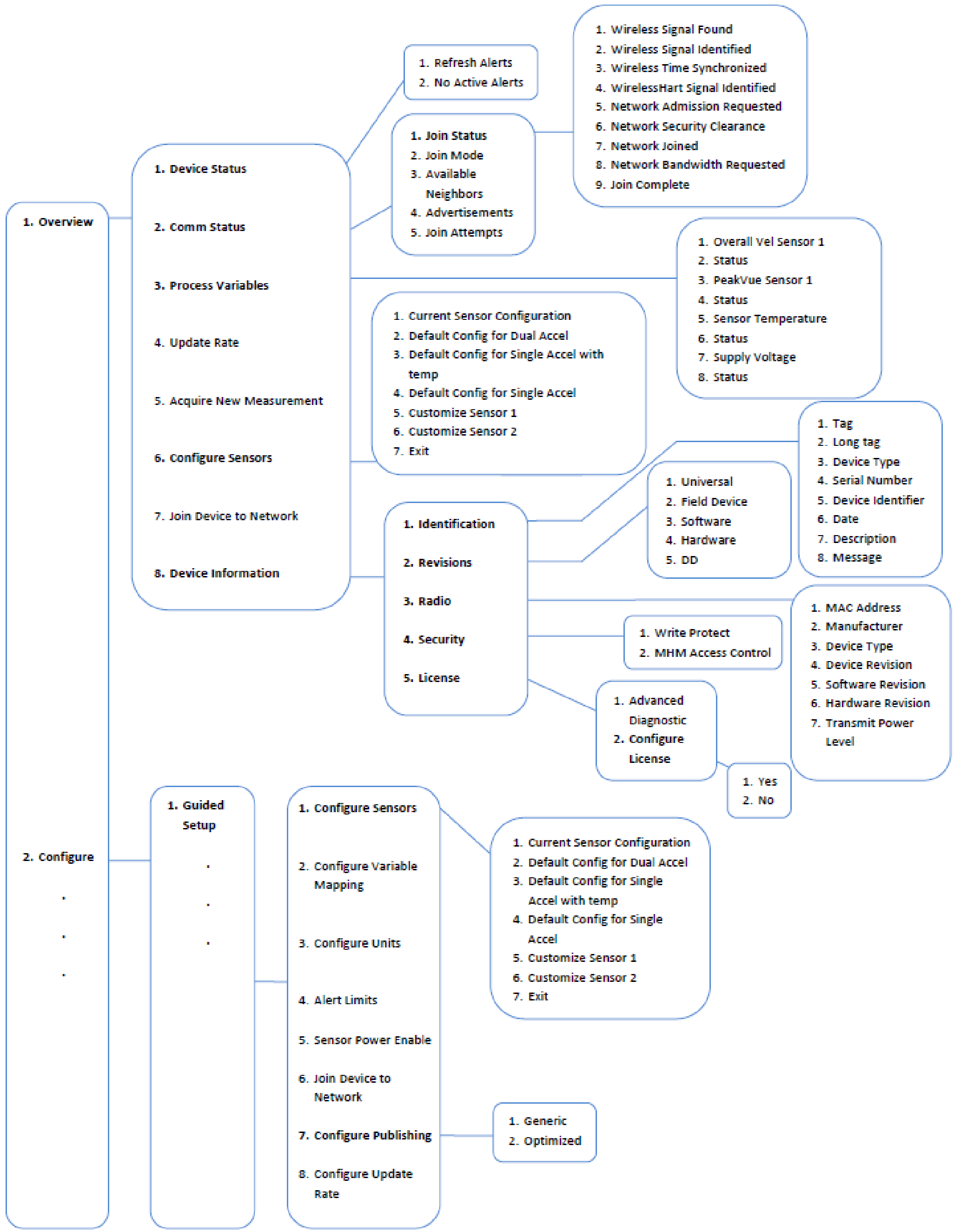


Figure 2-9: Field Communicator menu tree for CSI 9420, one accelerometer with temperature: 2 of 4

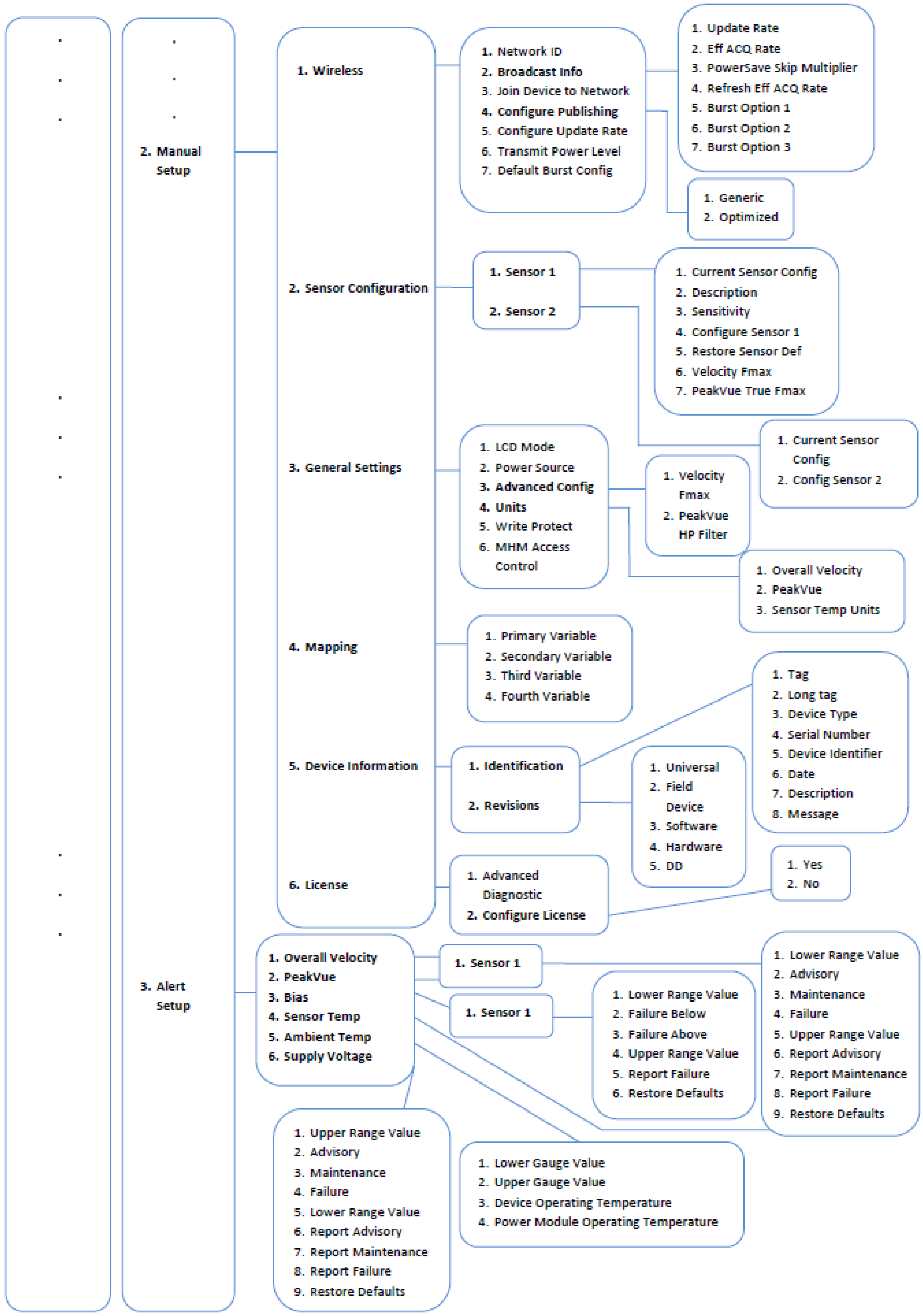
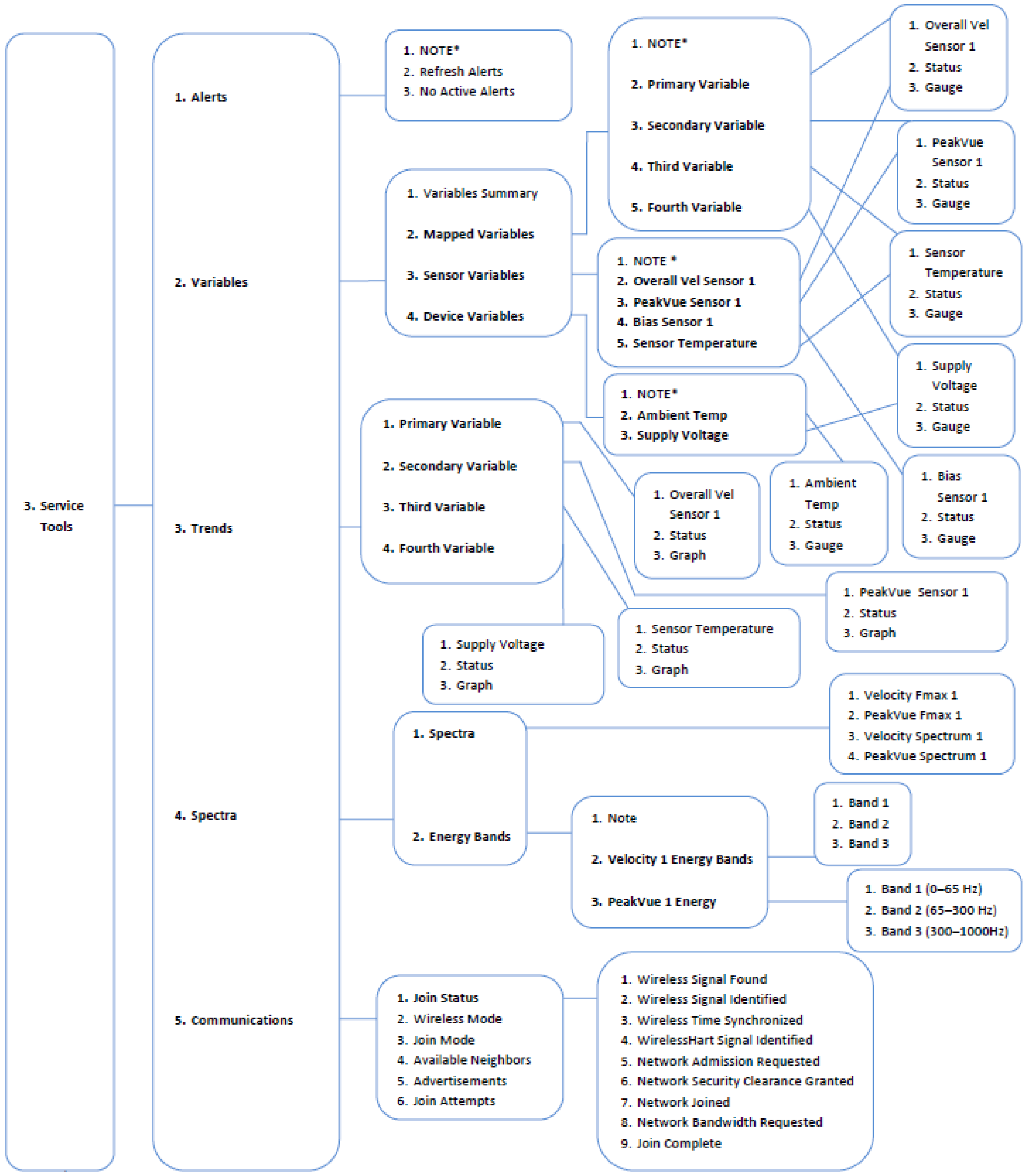


Figure 2-10: Field Communicator menu tree for CSI 9420, one accelerometer with temperature: 3 of 4



**This is only displayed when the device is configured to use the optimized burst mode.*

Figure 2-11: Field Communicator menu tree for CSI 9420, one accelerometer with temperature: 4 of 4

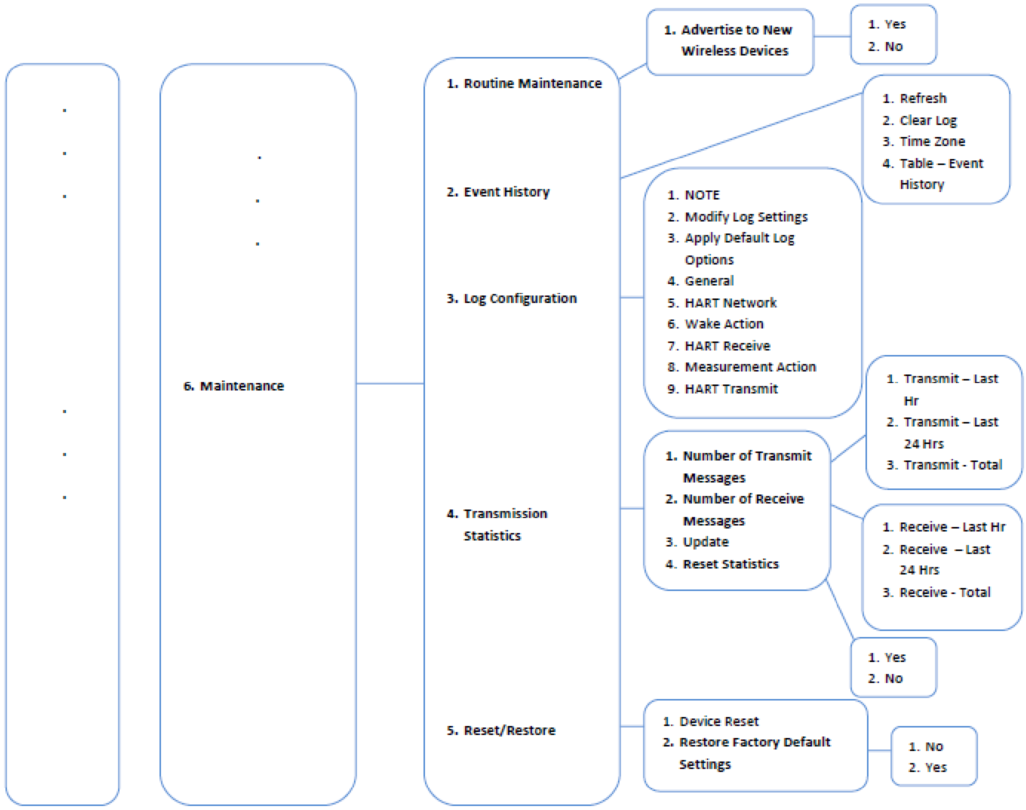


Figure 2-12: Field Communicator menu tree for CSI 9420, two accelerometers: 1 of 4

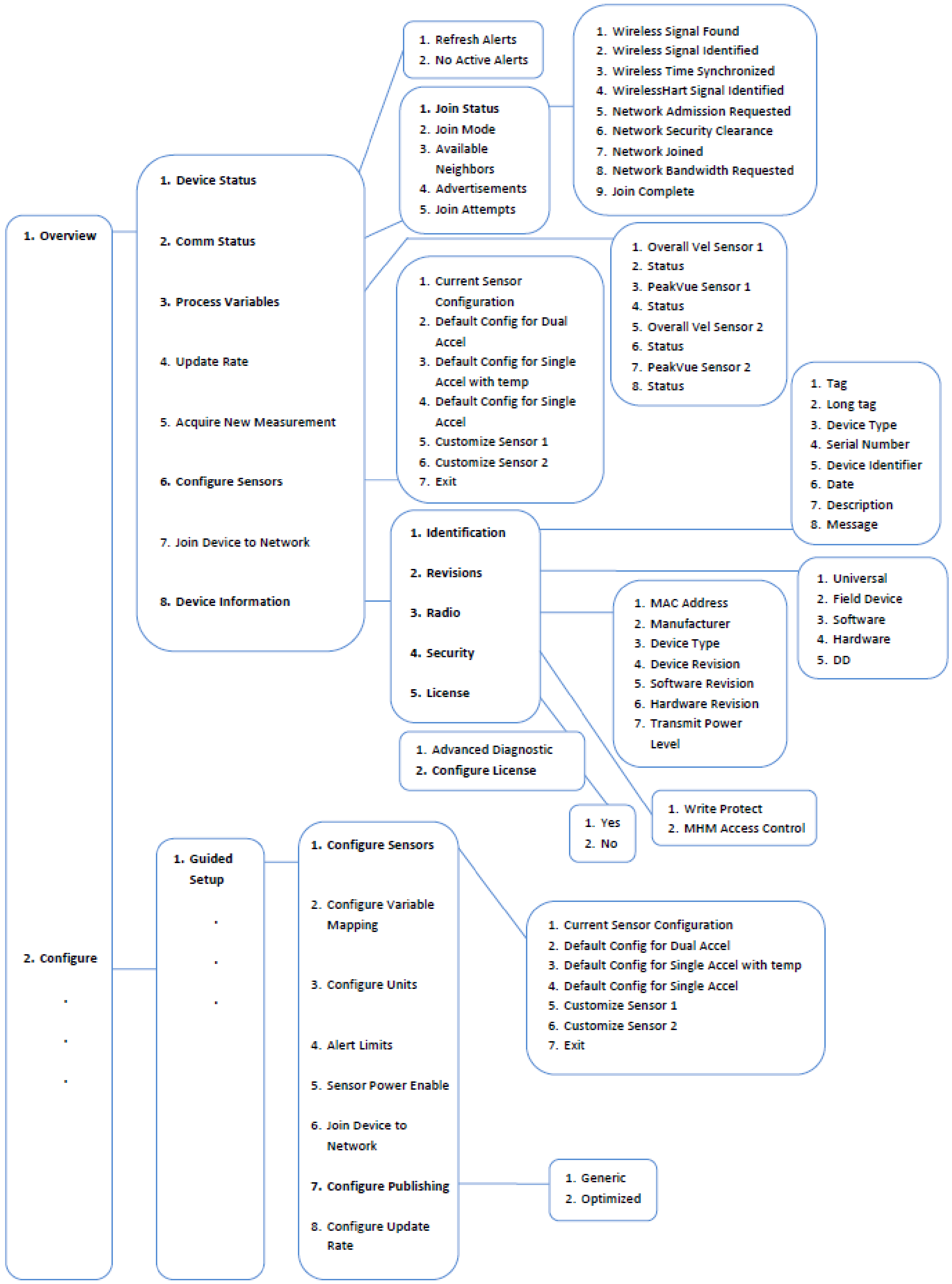


Figure 2-13: Field Communicator menu tree for CSI 9420, two accelerometers: 2 of 4

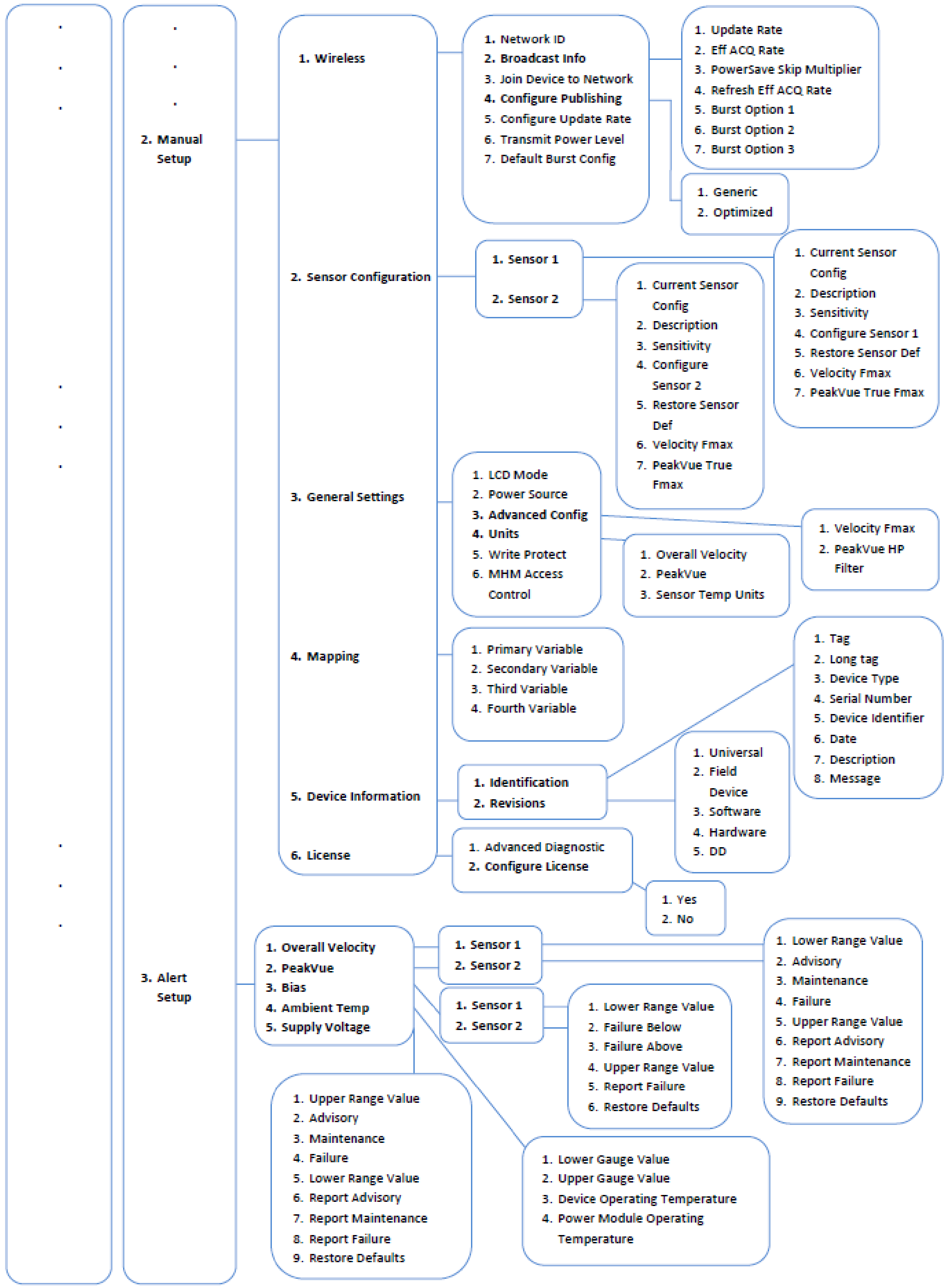
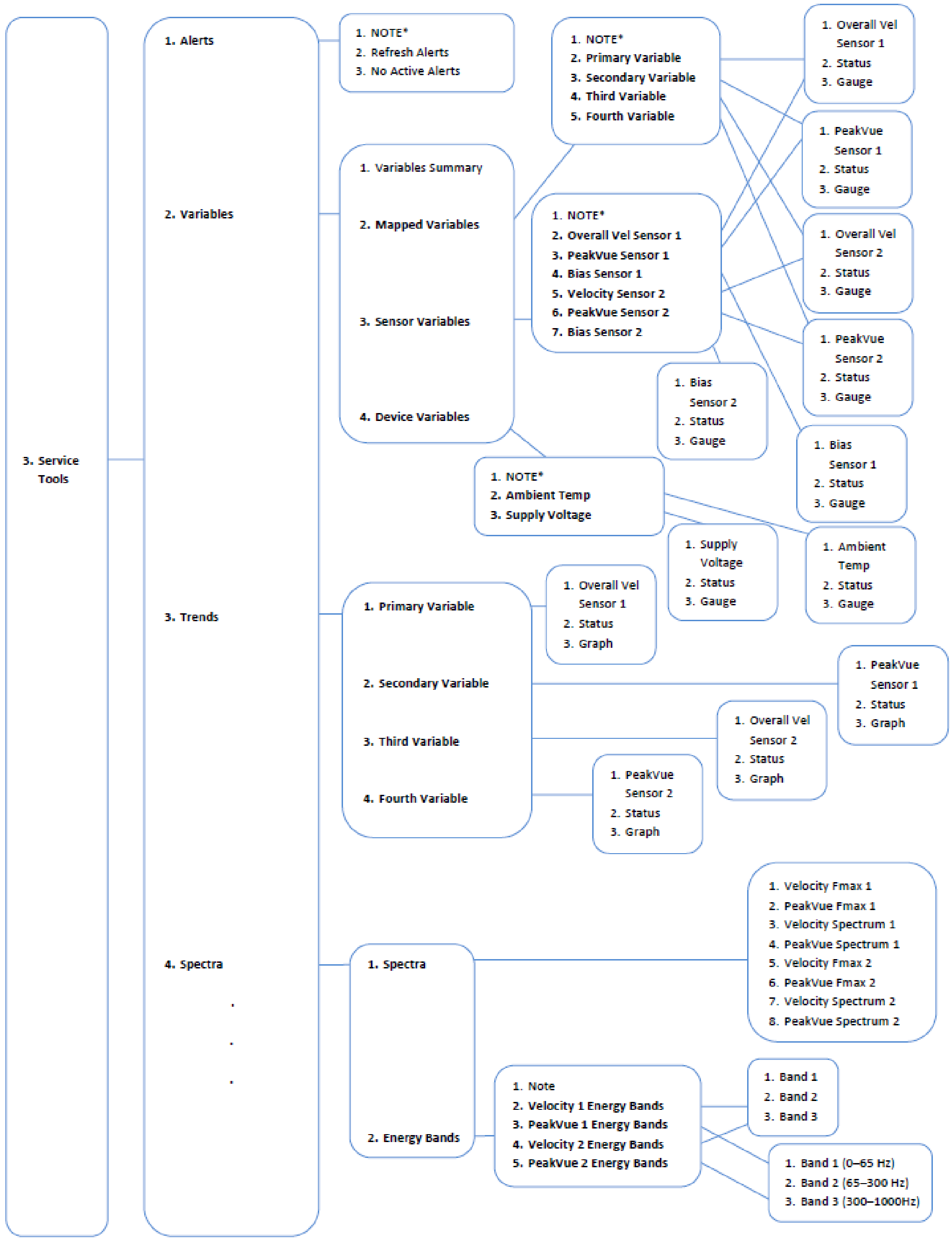
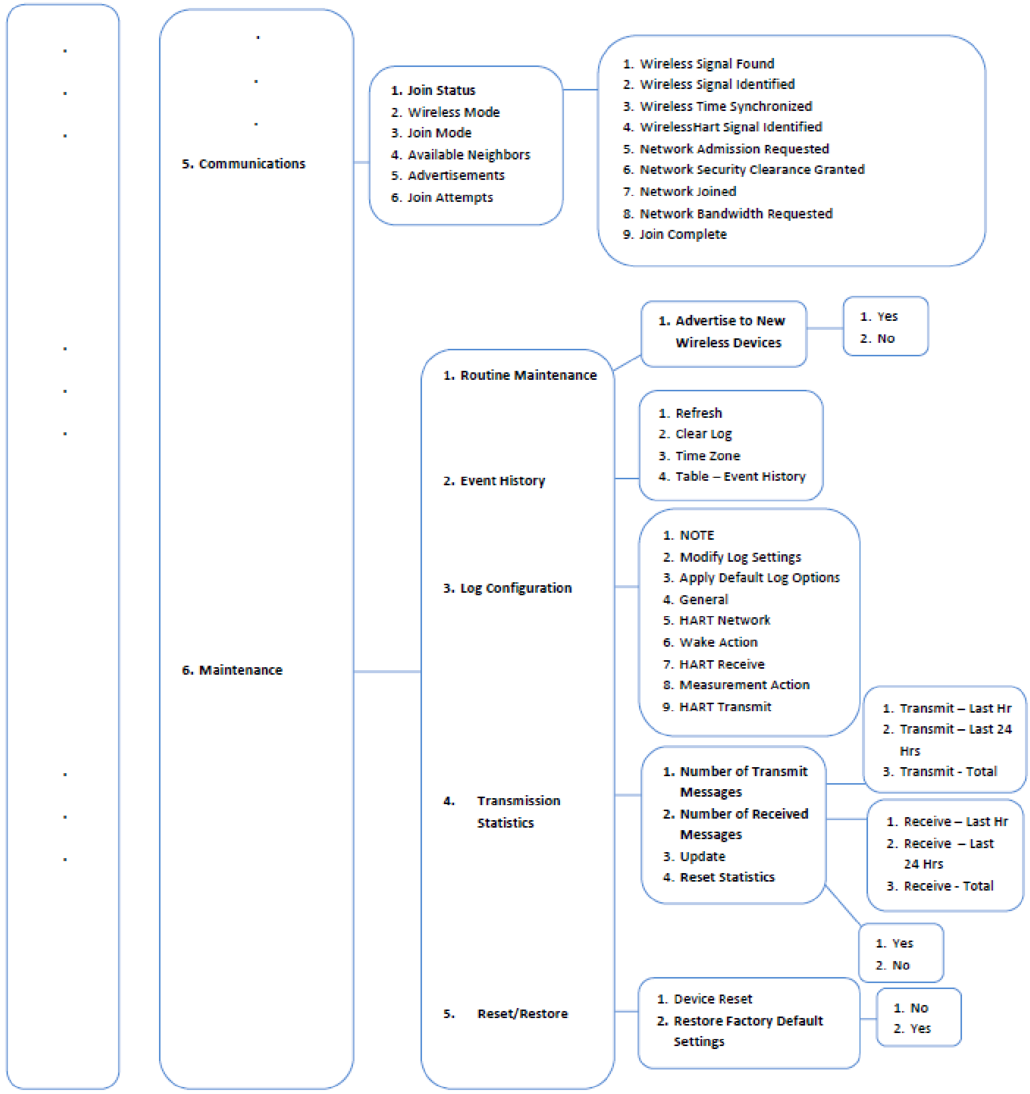


Figure 2-14: Field Communicator menu tree for CSI 9420, two accelerometers: 3 of 4



*This is only displayed when the device is configured to use the optimized burst mode.

Figure 2-15: Field Communicator menu tree for CSI 9420, two accelerometers: 4 of 4



2.2.1 Field Communicator fast key sequences

The following fast key sequences assume that you are using a Rev 4 DD. Press Send to save the changes to the device.

Table 2-7: CSI 9420 network configuration

Key sequence	Menu items
2, 2, 1 (Manual Setup)	Network ID Broadcast Info Join Device to Network Configure Publishing Configure Update Rate Transmit Power Level Default Burst Config
2, 1 (Guided Setup)	Configure Sensors Configure Variable Mapping Configure Units Alert Limits Sensor Power Enable Join Device to Network Configure Publishing Configure Update Rate

Table 2-8: CSI 9420 common fast key sequences

Function	Key sequence	Menu items
General settings	2, 2, 3 (Manual Setup)	LCD Mode Power Source Advanced Config Units Write Protect MHM Access Control
Alert setup	2, 3	Overall Velocity PeakVue Bias Ambient Temperature Supply Voltage
Update rate	2, 1, 8 (Guided Setup) 2, 2, 1, 5 (Manual Setup)	Configure Update Rate
Publishing mode	2, 1, 7 (Guided Setup) 2, 2, 1, 4 (Manual Setup)	Configure Publishing
Write protect	2, 2, 3, 5 (Manual Setup)	Write Protect

Table 2-8: CSI 9420 common fast key sequences *(continued)*

Function	Key sequence	Menu items
Power options	2, 2, 3, 2 (Manual Setup)	Power Source
MHM Access Control	2, 2, 3, 6 (Manual Setup)	MHM Access Control
Supply power to sensor	2, 1, 5 (Guided Setup)	Sensor Power Enable
Configure variable mapping	2, 1, 2 (Guided Setup)	Configure Variable Mapping
Device reset	3, 6, 5	Device Reset Restore Factory Default Settings

2.3 Configuration with AMS Device Manager

2.3.1 Configure wireless network credentials in AMS Device Manager

Prerequisites

Before performing operations in AMS Device Manager, first scan the CSI 9420 with a wired HART modem. Right-click the HART Modem icon in Device Explorer and select Scan All Devices.

Note
Configuring the wireless network is only applicable using a wired HART modem and cannot be done using WirelessHART devices.

Procedure

1. Right-click the CSI 9420 device and select Methods > Join Network.
2. Enter the network ID for the wireless network in the Join Device to Network screen and click Next.

   You can obtain the network ID from the Smart Wireless Gateway web server. Click Setup > Network > Settings.

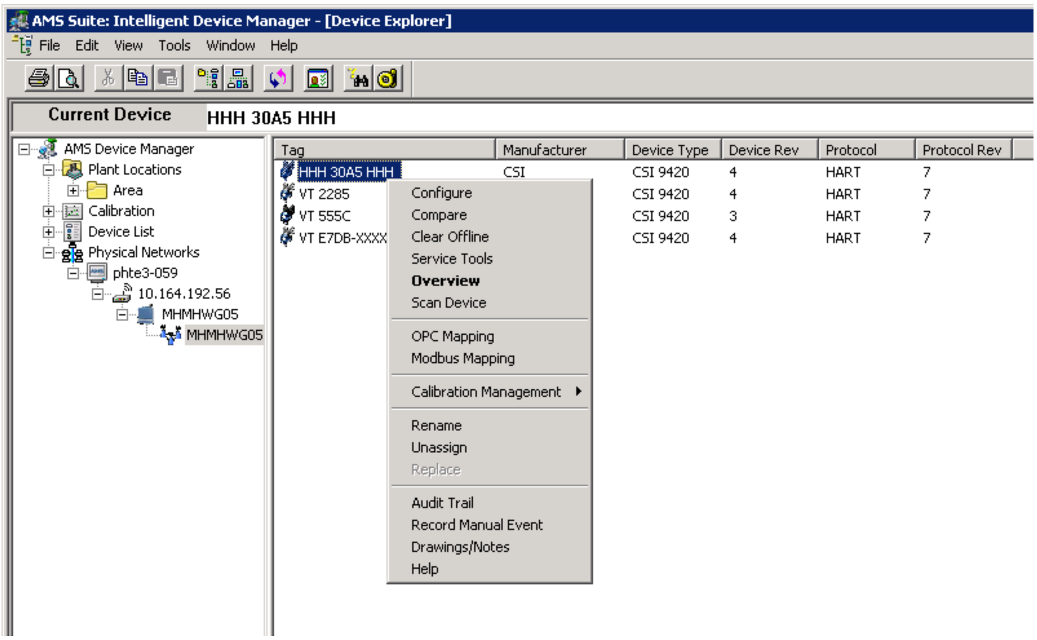
3. Enter the Join Key in the screens that follow, and click Next.
4. Select the Accept new join key option, and click Next.
5. Click Finish when done.

2.3.2 Right-click menu

The right-click menu of the CSI 9420 device in AMS Device Manager provides a quick link to the Configure, Compare, Service Tools, and Overview windows, as well as to other context menus available for the device. This document only discusses the Overview, Configure, and Service Tools windows; for more information on the other context menus, refer to AMS Device Manager Books Online.

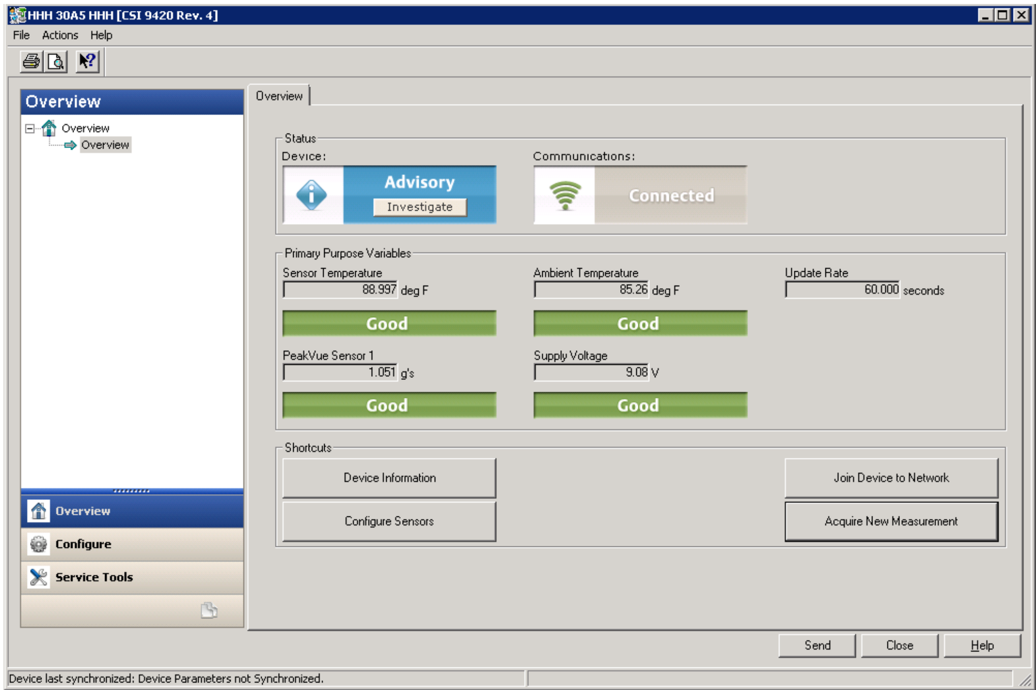
In the Device Explorer view, select the wireless network where the transmitter is connected and right-click the transmitter to display the context menus.

Figure 2-16: CSI 9420 right-click menu



Overview

Figure 2-17: Overview window



The Overview window provides a glimpse of the status of the CSI 9420, including the primary purpose variables associated with it.

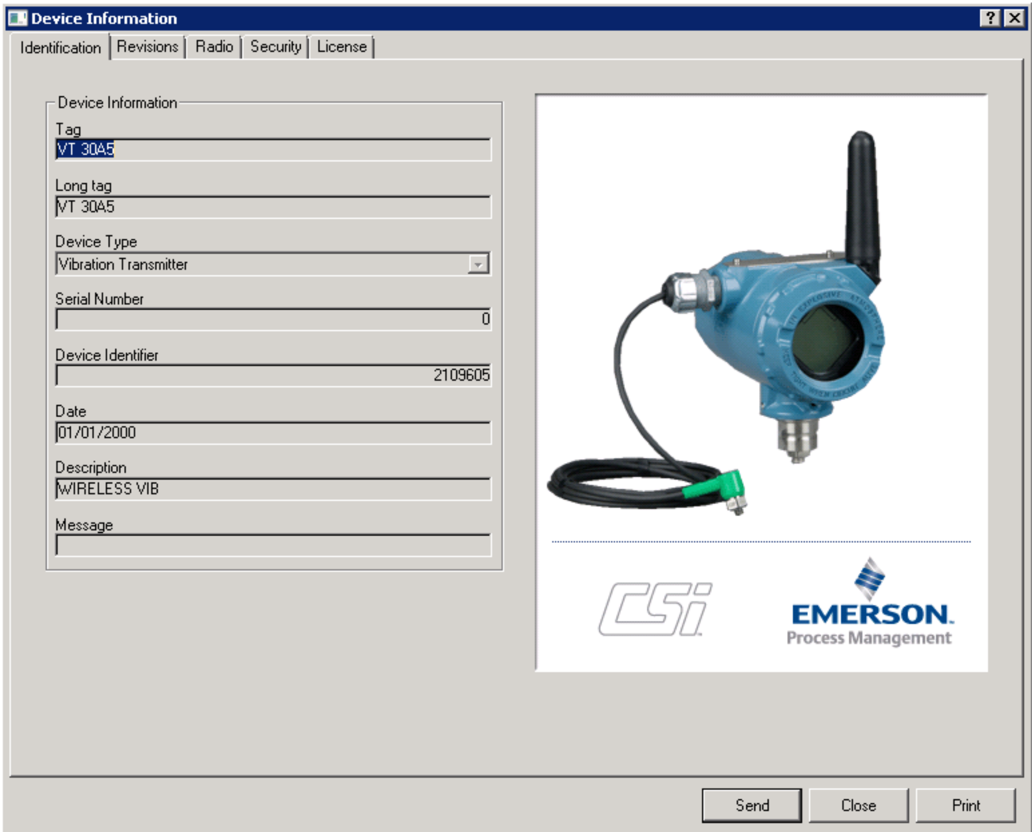
You can also access the following shortcuts from this page:

- Device Information
- Configure Sensors
- Join Device to Network
- Acquire New Measurement

Device Information

From the Overview window, click Device Information to display relevant device information.

Figure 2-18: Device Information window



Click the Identification tab to display the device tag, long tag, device type, serial number, identifier, and description.

Click the Revisions tab to display the universal, field device, software, hardware, and DD revision numbers.

Click the Radio tab to display the device MAC address, manufacturer, device type, revision numbers, and transmit power level.

Click the Security tab to display Write Protect information and to view whether MHM Access Control is enabled.

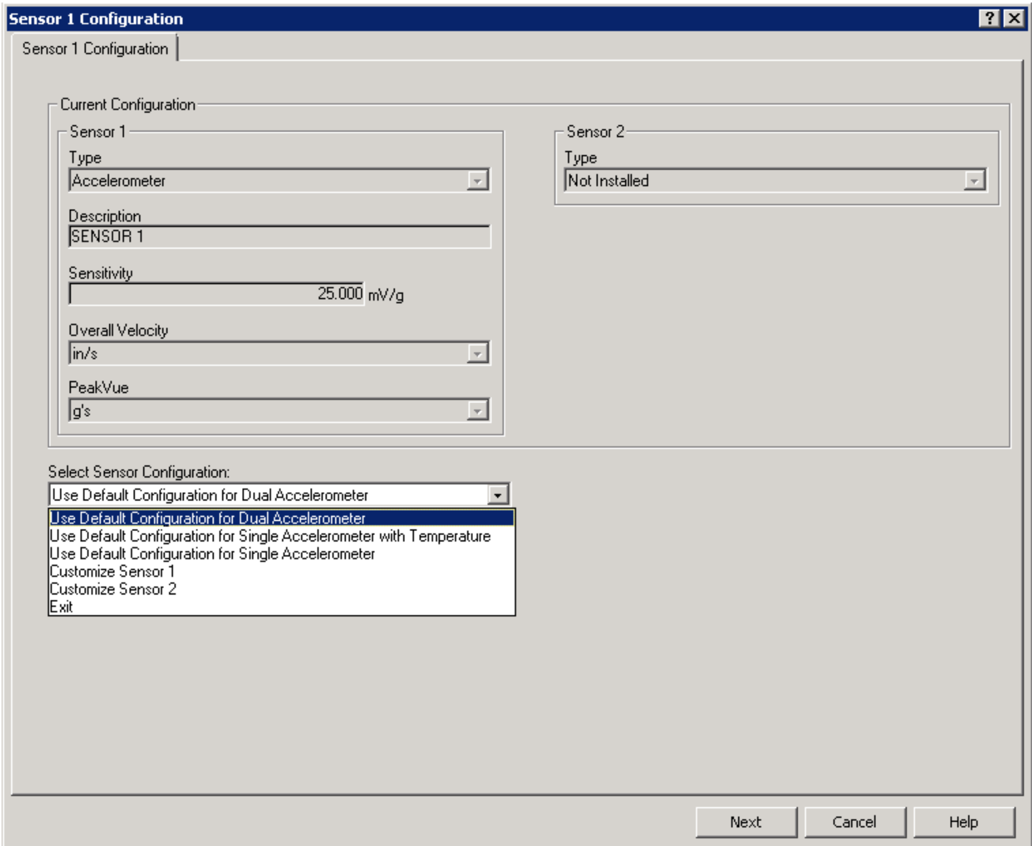
Click the License tab to display installed licensable features such as the Advanced Diagnostics application.

Click License tab > Configure License to configure/change installed licenses.

Configure Sensors

From the Overview window, click Configure Sensors to display installed sensors and current sensor configurations.

Figure 2-19: Sensor Configuration window

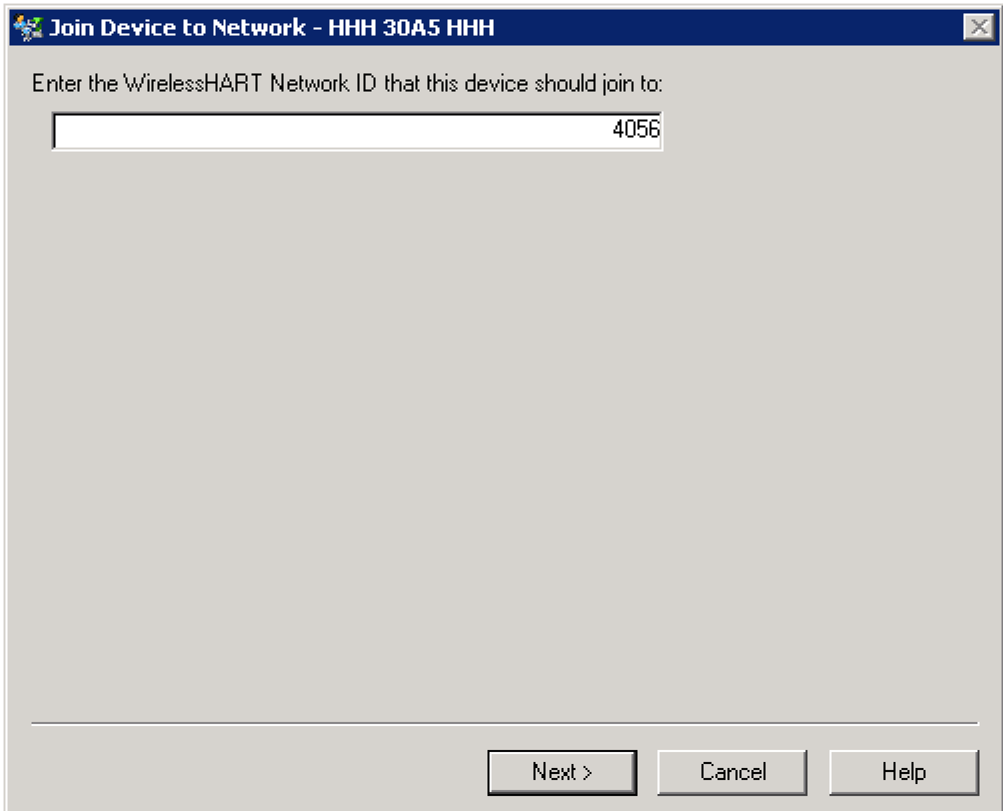


Click the Select Sensor Configuration drop-down to select a sensor configuration to apply to the installed sensors.

Join Device to Network

From the Overview window, click Join Device to Network to enter network identifiers and join keys that will enable the transmitter to join a wireless network.

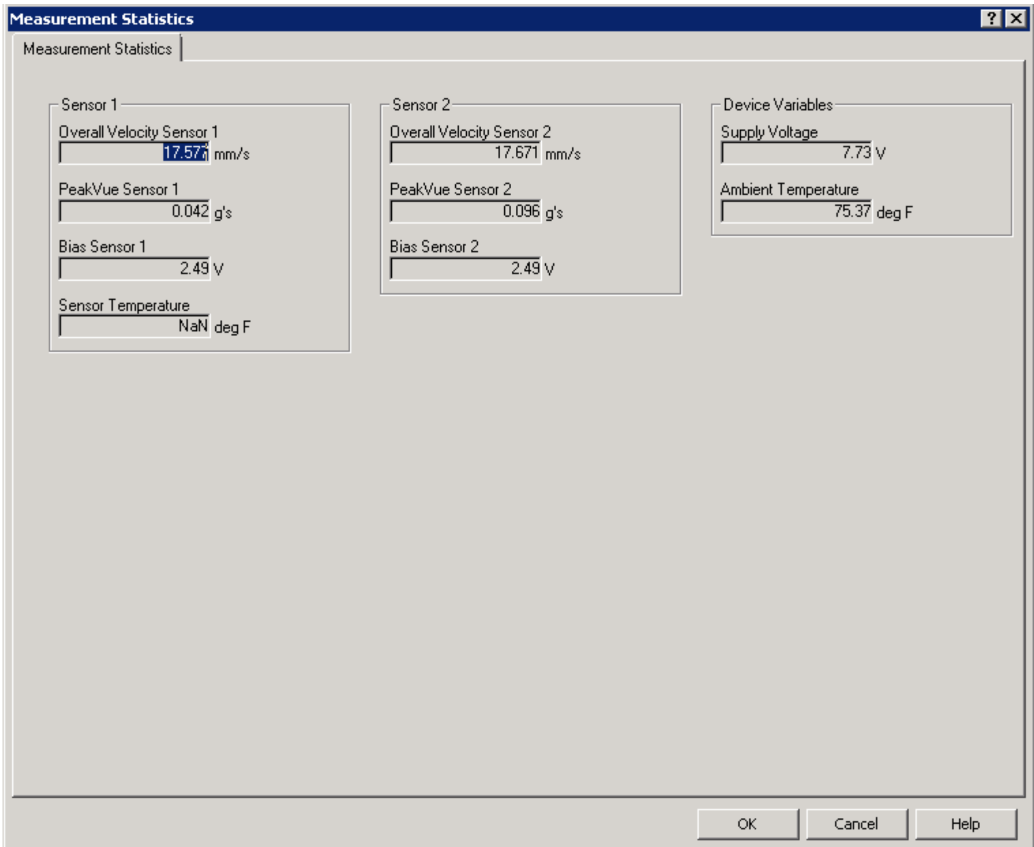
Figure 2-20: Join Device to Network window



Acquire New Measurement

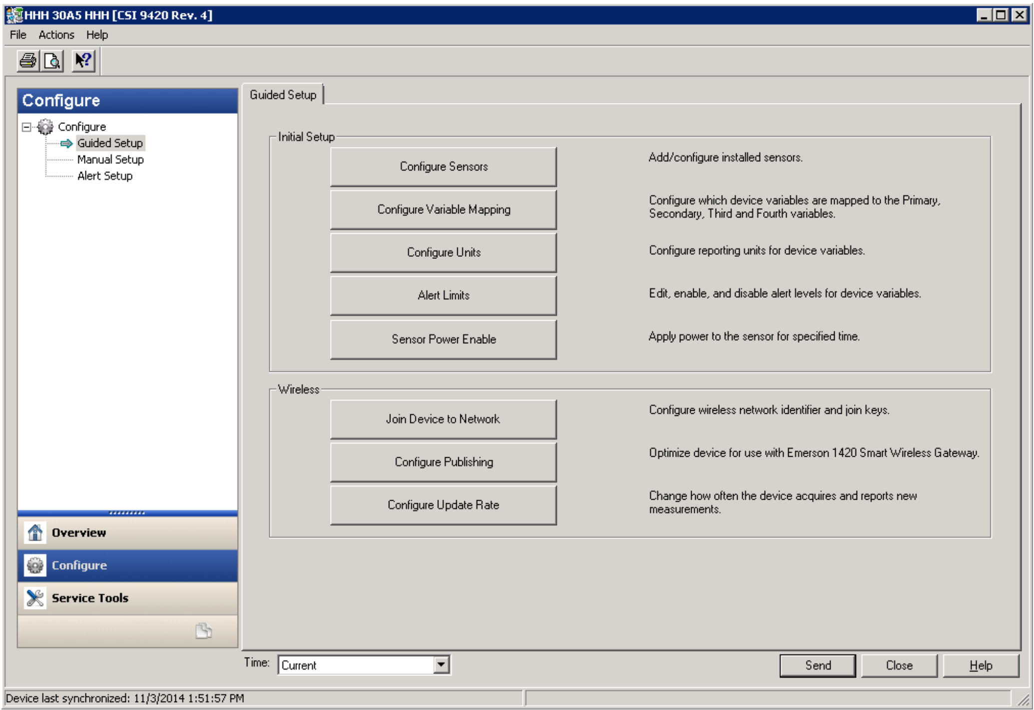
From the Overview window, click Acquire New Measurement to display measurement statistics for Velocity, PeakVue, bias, and sensor temperature for installed sensors. This also displays supply voltage and ambient temperature information for the transmitter.

Figure 2-21: Measurement Statistics window



Configure

Figure 2-22: Configure window



The Configure window lets you configure device settings.

Important

To be able to edit configuration settings, select Current in the Time drop-down menu at the bottom of the screen.

Guided Setup

Guided Setup lets you configure device settings in a guided step-by-step process.

Click Configure Sensors to display or configure installed sensors.

Click Configure Variable Mapping to display or specify which measurements are reported as the Primary, Secondary, Third, and Fourth variables.

Click Configure Units to configure units for Overall Velocity, PeakVue, and temperature.

Click Alert Limits to define the lower range and upper range values and alert limits for Advisory, Maintenance, and Failure for each of the process variables. You can also configure alert reporting from here.

Click Sensor Power Enable to supply power to the sensor for a specific amount of time.

Note

Sensor Power Enable is only available when the device is connected to AMS Device Manager using a USB or serial HART modem and when the device is connected to a Field Communicator. This feature is not available when the device is connected to AMS Device Manager using a WirelessHART connection.

Click Join Device to Network to enter network identifiers and join keys that will enable the transmitter to join a wireless network.

Click Configure Publishing to set how parameters are published (generic or optimized).

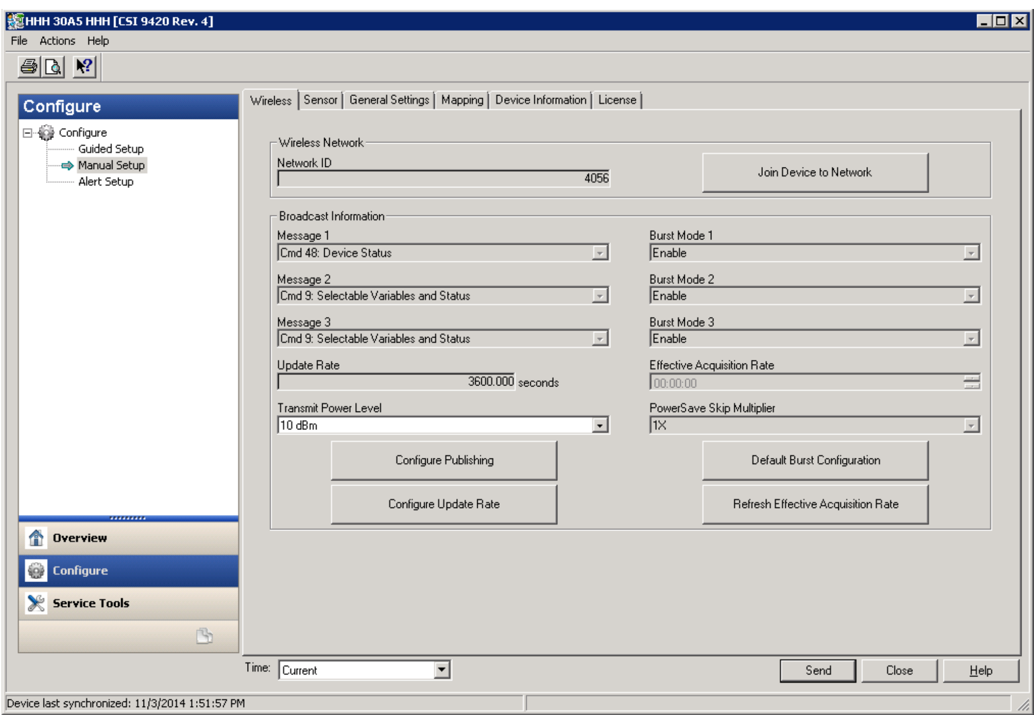
Click Configure Update Rate to set how often the device acquires and reports new measurements (update rate) and to specify the number of times the transmitter skips data acquisitions between updates to the gateway (PowerSave Skip Multiplier).

Manual Setup

Manual Setup lets you configure device settings manually.

Click the Wireless tab to display wireless network information for the transmitter.

Figure 2-23: Wireless tab



Click Join Device to Network to enter network identifiers and join keys that will enable the transmitter to join a wireless network.

Click Configure Publishing to set how parameters are published (generic or optimized).

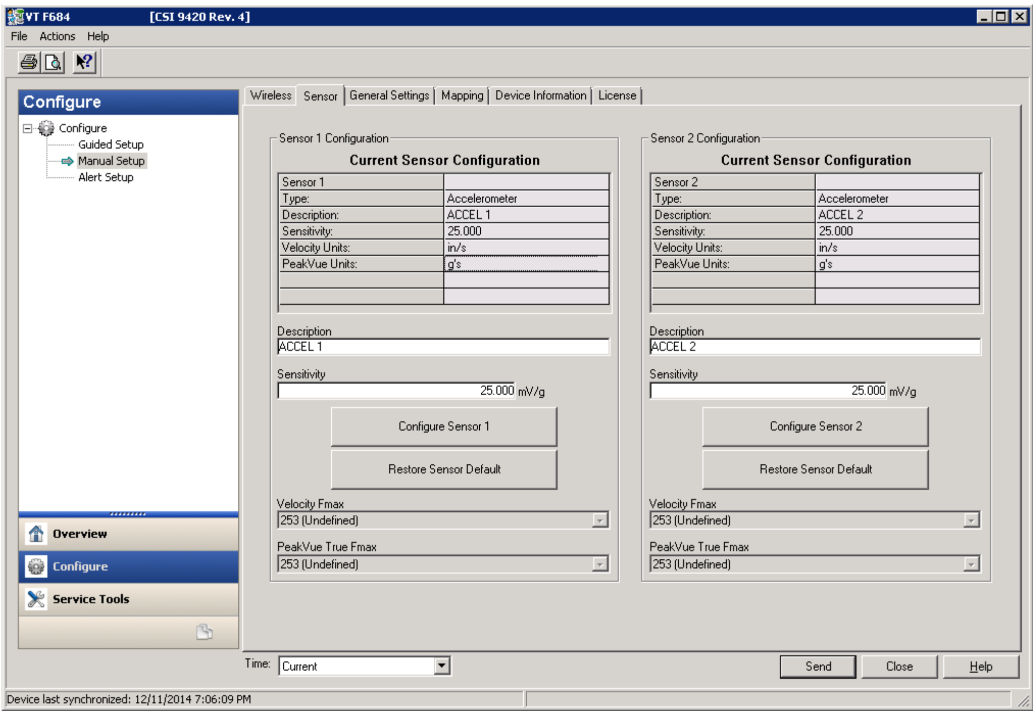
Click Configure Update Rate to set how often the device acquires and reports new measurements (update rate) and to specify the number of times the transmitter skips data acquisitions between updates to the gateway (PowerSave Skip Multiplier).

Click Default Burst Configuration to reset the burst configuration to default values.

Click Refresh Effective Acquisition Rate to refresh the value in the Effective Acquisition Rate field.

Click the Sensor tab to display current sensor configurations. You can also edit the sensor sensitivity value from this page.

Figure 2-24: Sensor tab

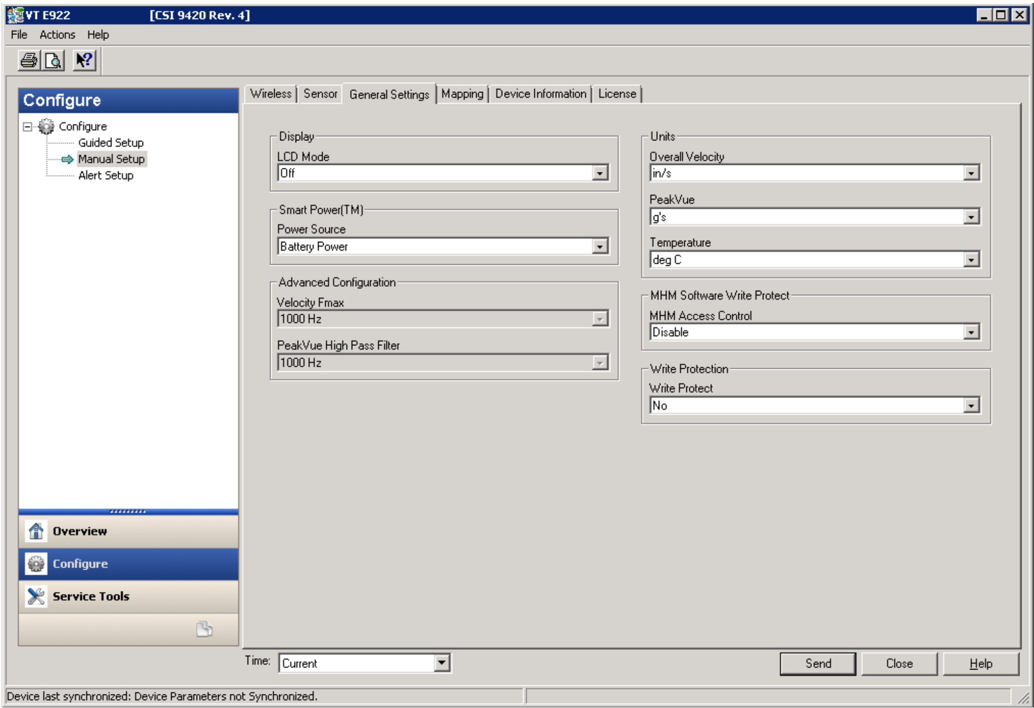


Click Configure Sensor x to configure the parameters for the specific sensor.

Click Restore Sensor Default to reset the sensor parameters to default values.

Click the General Settings tab to display or edit general transmitter settings.

Figure 2-25: General Settings tab



Click the LCD Mode drop-down to enable or disable the LCD, or to set it to troubleshooting mode.

Click the Power Source drop-down to select the transmitter power source.

Select the units for measurement variables from the Overall Velocity, PeakVue, and Temperature drop-down menus.

Click the MHM Access Control drop-down to enable or disable Access Control for AMS Machinery Manager. Access Control allows AMS Machinery Manager to make changes to the CSI 9420 configuration.

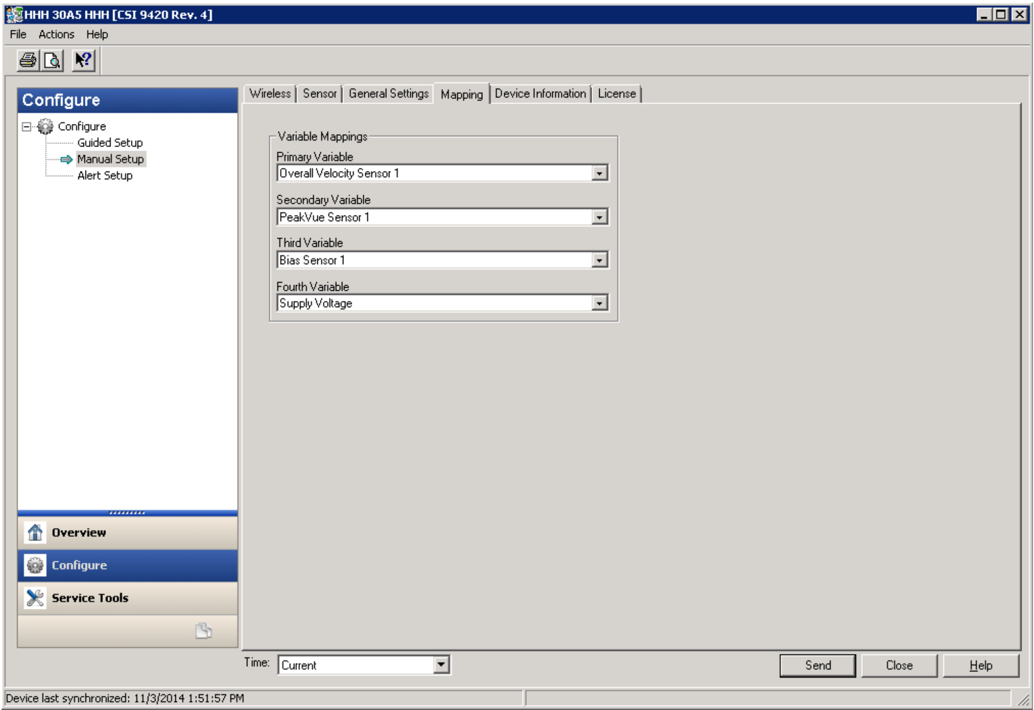
⚠ CAUTION!

If the device will be commissioned in a HART DCS host (e.g., DeltaV or Ovation), do not enable AMS Machinery Manager to make changes to the configuration.

Click the Write Protect drop-down to specify whether variables can be written to the device.

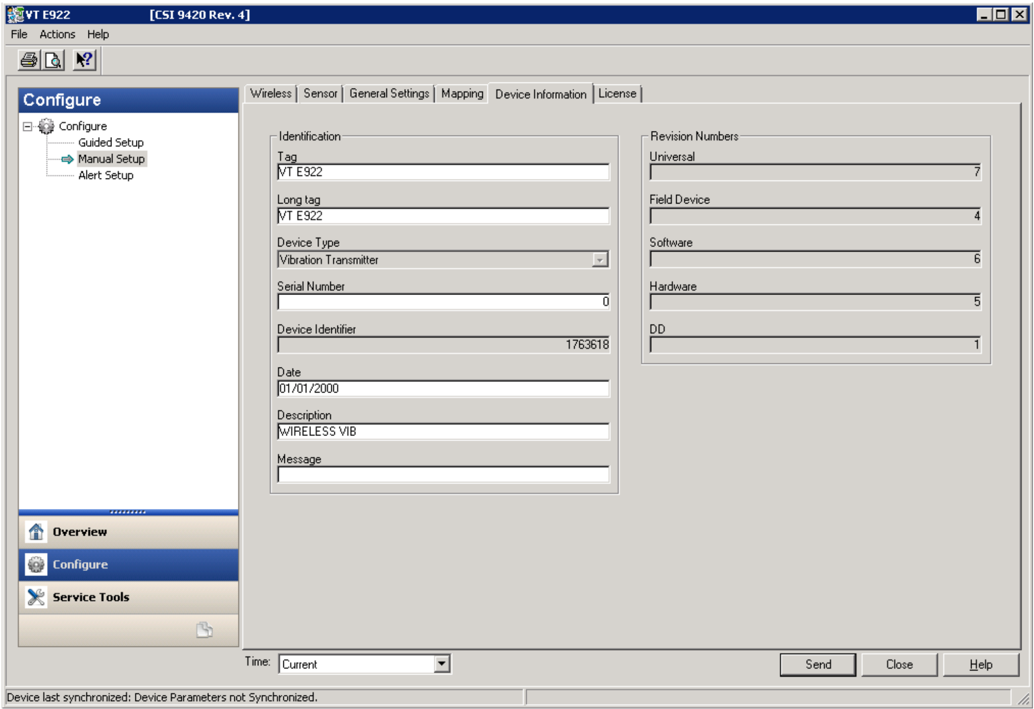
Click the Mapping tab to specify which measurements are reported as the Primary, Secondary, Third, and Fourth variables.

Figure 2-26: Mapping tab



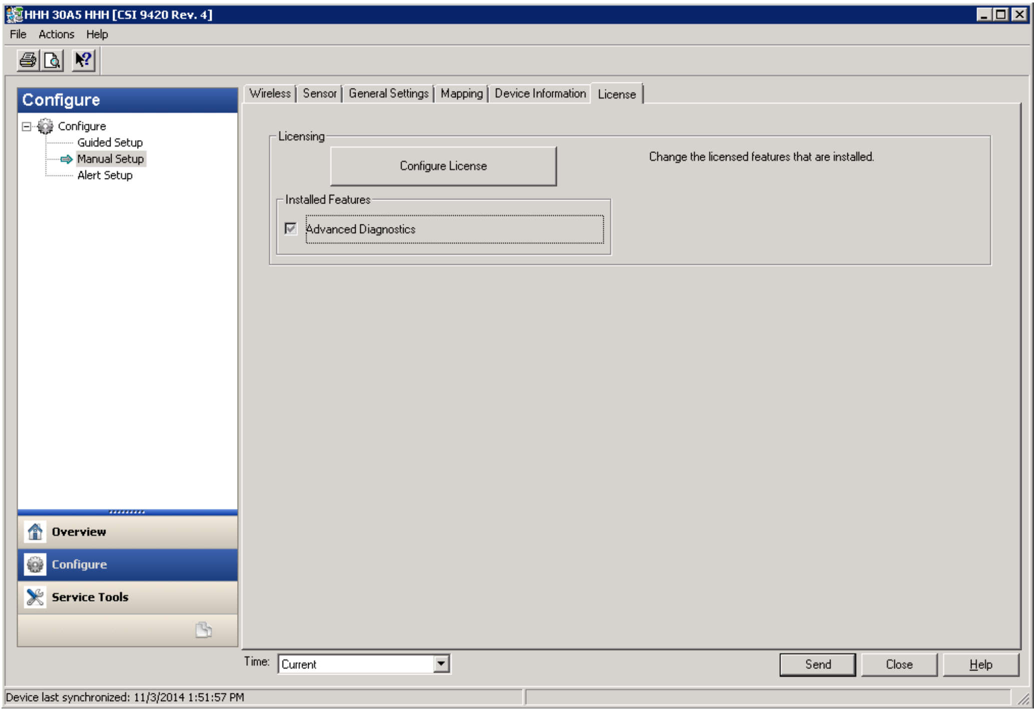
Click the Device Information tab to display the device tag, long tag, device type, serial number, device identifier, and description, and to display the universal, field device, software, hardware, and DD revision numbers.

Figure 2-27: Device Information tab



Click the License tab to display installed licensable features such as the Advanced Diagnostics application.

Figure 2-28: License tab

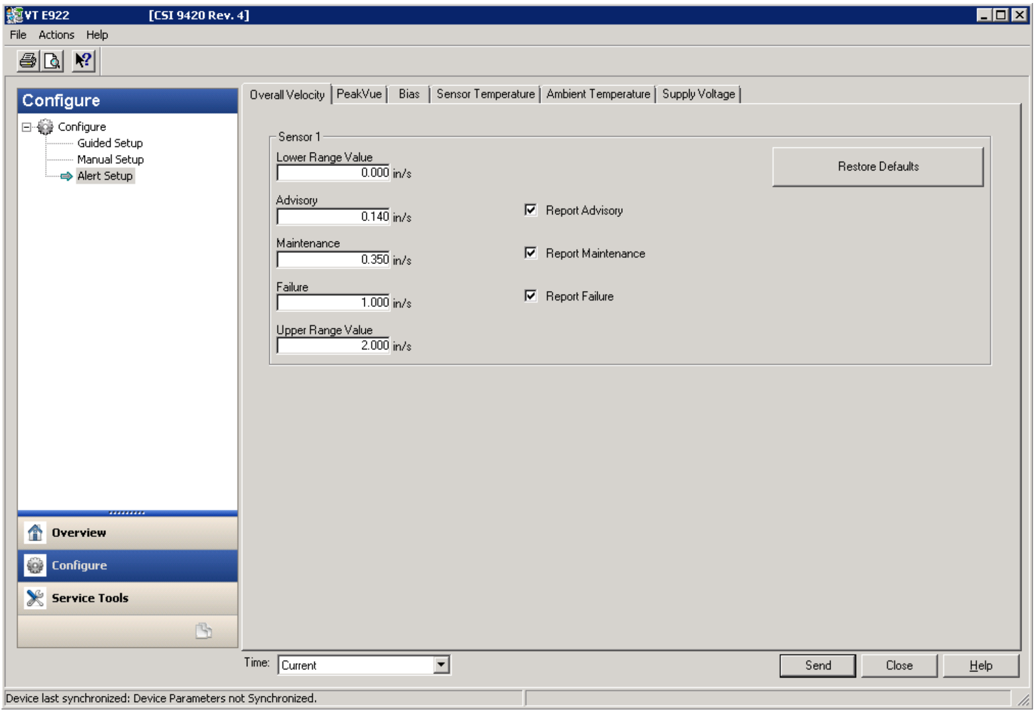


Click Configure License to configure/change installed licenses.

Alert Setup

Alert Setup lets you configure the upper and lower range values and alarm limits for Overall Velocity, PeakVue, Bias, Sensor Temperature, Ambient Temperature, and Supply Voltage.

Figure 2-29: Alert Setup

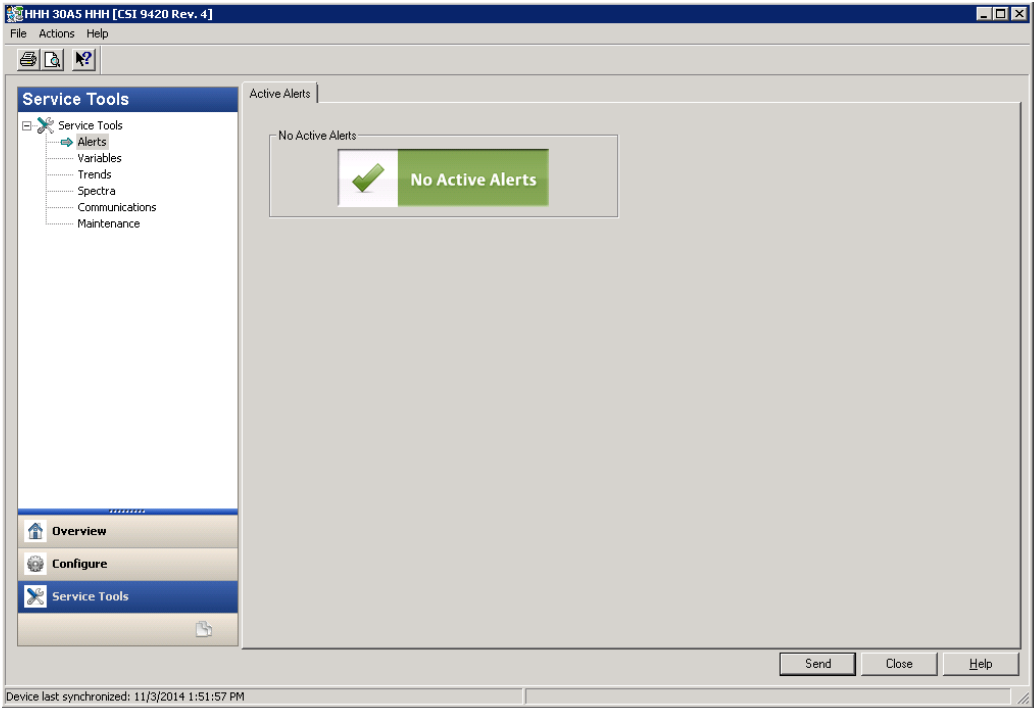


Click the corresponding sensor/device variable tab and select the Report Advisory, Report Maintenance, or Report Failure check boxes to generate alarms when actual measured values exceed the thresholds specified. When these check boxes are not selected, no alarm is reported.

Click Restore Defaults to restore default alarm thresholds for the selected variable.

Service Tools

Figure 2-30: Service Tools window



The Service Tools window displays alert conditions. These include hardware and software malfunctions or parameters with values beyond specifications.

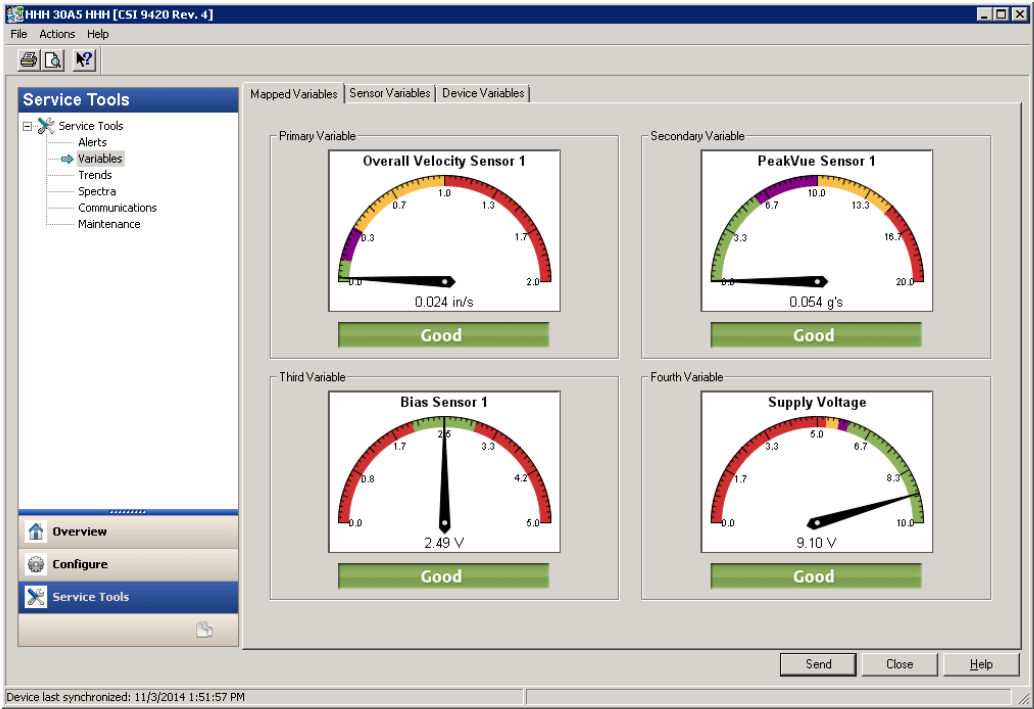
Alerts

Click Alerts to display active alerts for the device.

Variables

Click Variables to display graphical gauges of sensor and device variables.

Figure 2-31: Variables



Click the Mapped Variables tab to display graphical gauges of variables and their mappings.

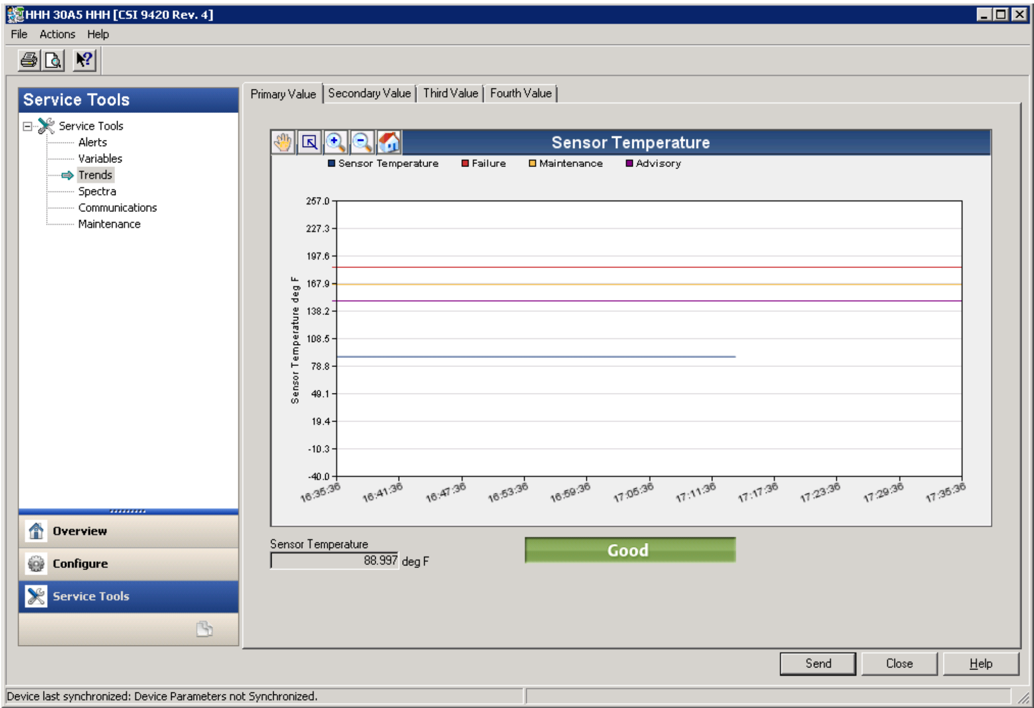
Click the Sensor Variables tab to display graphical gauges of the variables for each connected sensor.

Click the Device Variables tab to display graphical gauges of ambient temperature and supply voltage variables.

Trends

Click Trends to display hour-long trends for each of the four measurement variables (PV, SV, TV, and QV).

Figure 2-32: Trends



Note

The trend plots begin when Trends is selected, and continue to build as long as this remains selected.

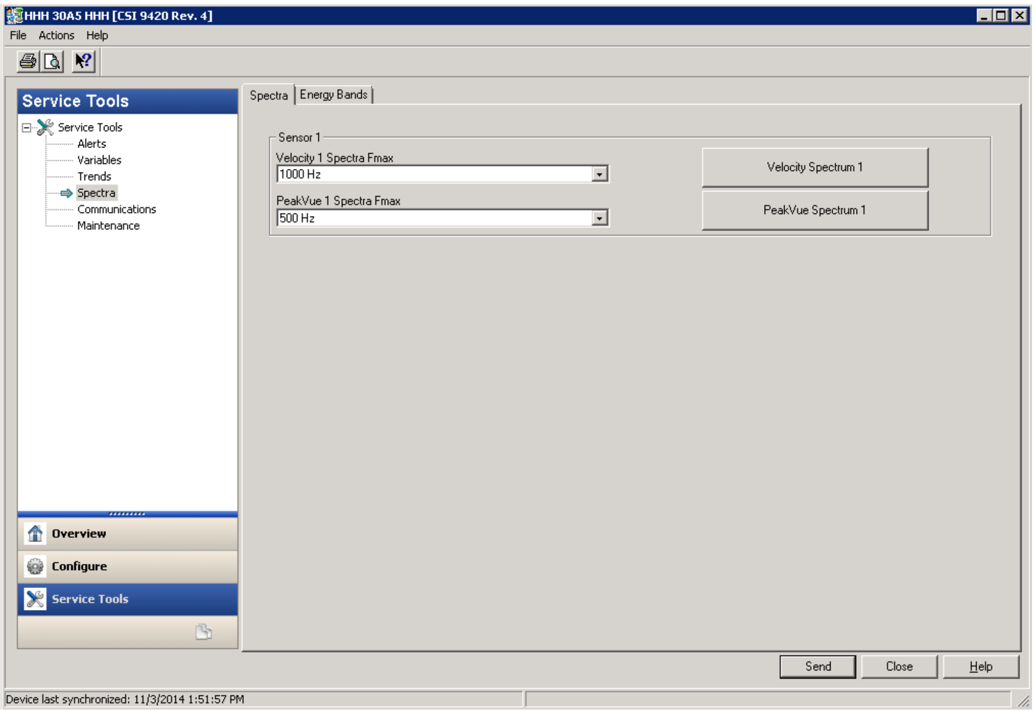
Spectra

Click Spectra to display spectral and analysis parameter data and to configure spectral data acquisition settings. You can import spectral data to AMS Machinery Manager for further analysis.

Note

You must have the Advanced Diagnostics application license to view this feature. For more information on the Advanced Diagnostics application, see *Section 2.4.1*.

Figure 2-33: Spectra



The Fmax settings define the default frequency range of the thumbnail spectra for Velocity and PeakVue. If you enable the Average Velocity option in AMS Machinery Manager, you can configure the high-resolution Velocity Analytical spectrum to return 400 or 800 lines of resolution, with averaging. If the Average Velocity option is not enabled in AMS Machinery Manager, the spectrum is calculated at 1600 lines of resolution, with no averaging.

When vibration data is acquired, a PeakVue waveform is sampled for 3.2 seconds. If you set the PeakVue True Fmax to 1000 Hz, the first 1.6 seconds of the PeakVue waveform is used for the analytical spectrum. If you set the Fmax to 500 Hz, the entire 3.2 second PeakVue waveform is used to calculate the analytical spectrum. Regardless of what you choose in Fmax, the overall PeakVue trend parameter is calculated over the entire 3.2 second waveform.

Click Velocity Spectrum x and PeakVue Spectrum x to display spectral plots of the latest acquired data for Velocity and PeakVue for connected sensors.

Figure 2-34: Velocity spectrum

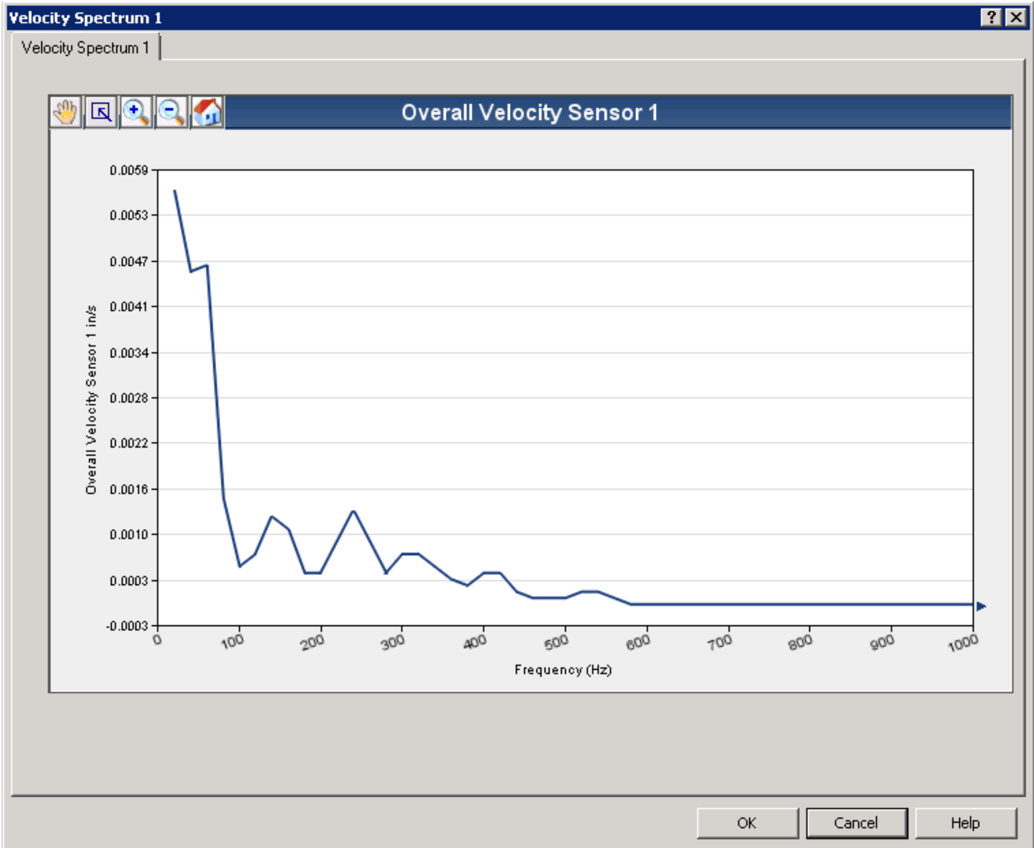
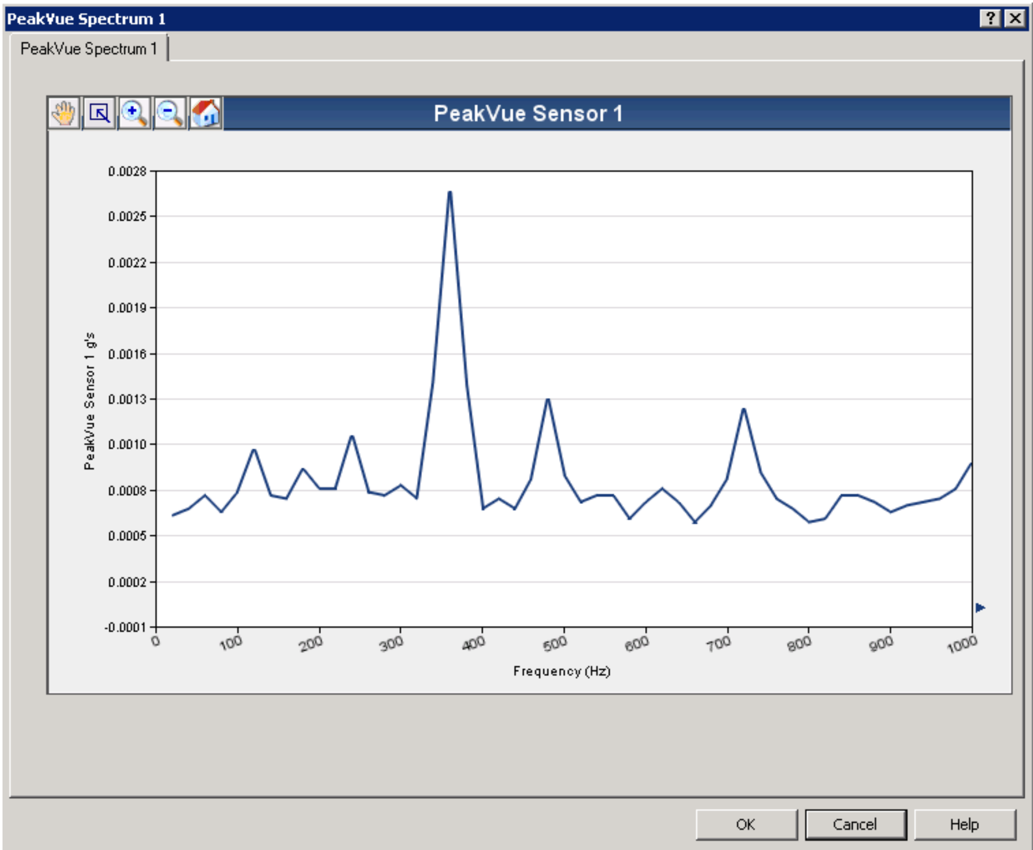
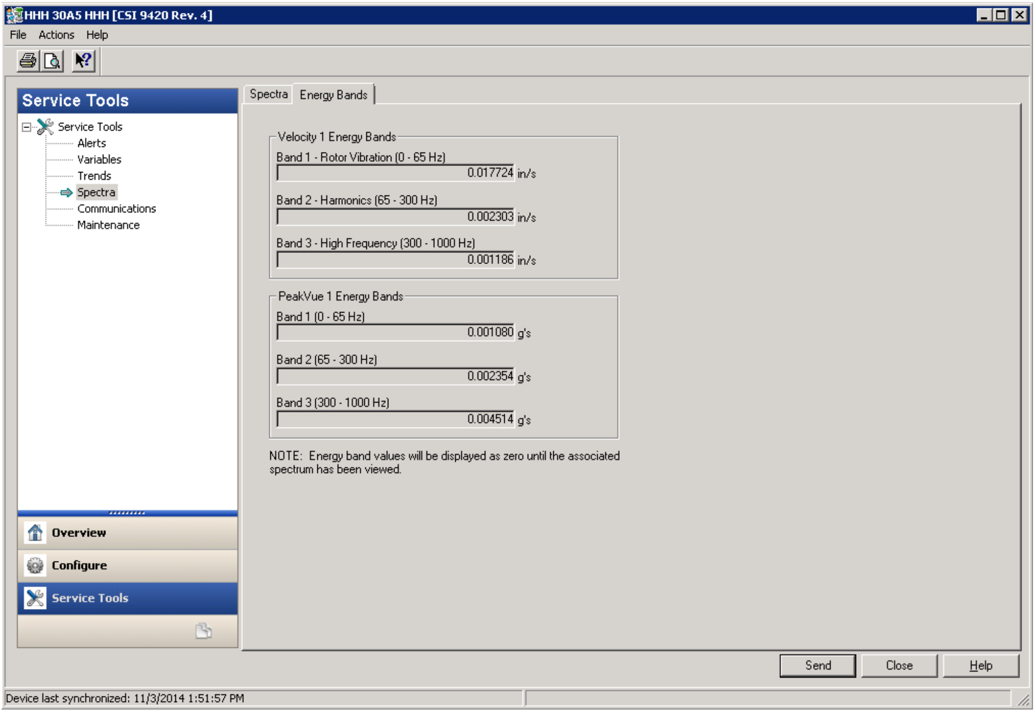


Figure 2-35: PeakVue spectrum



Click the Energy Bands tab to display calculated energy band values.

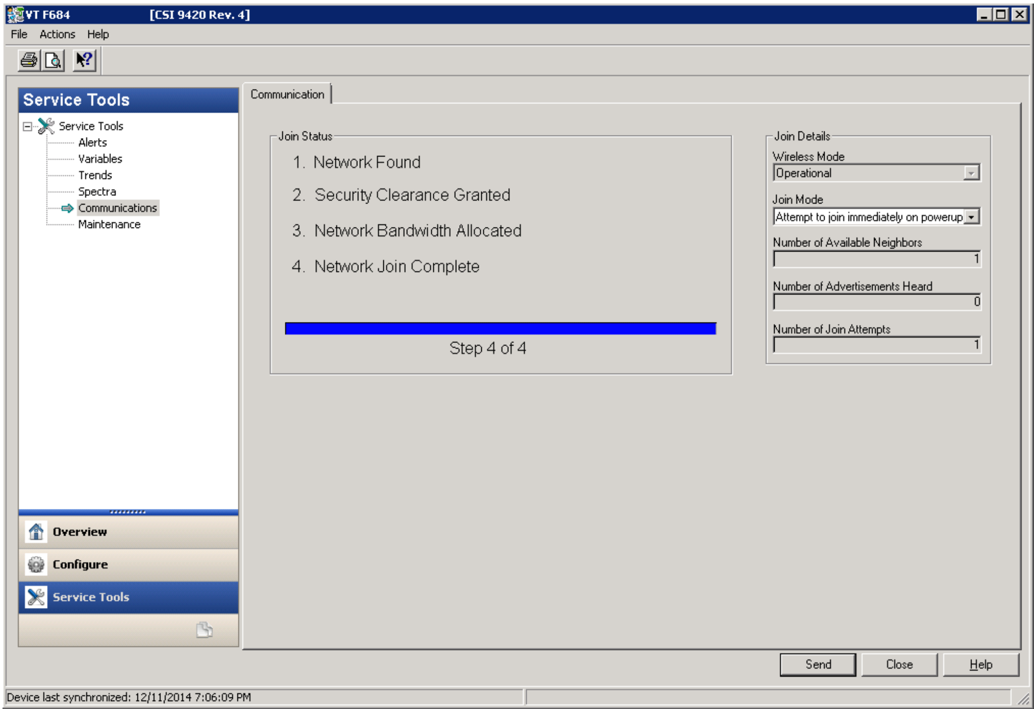
Figure 2-36: Energy Bands tab



Communications

Click Communications to display network join status information.

Figure 2-37: Communications

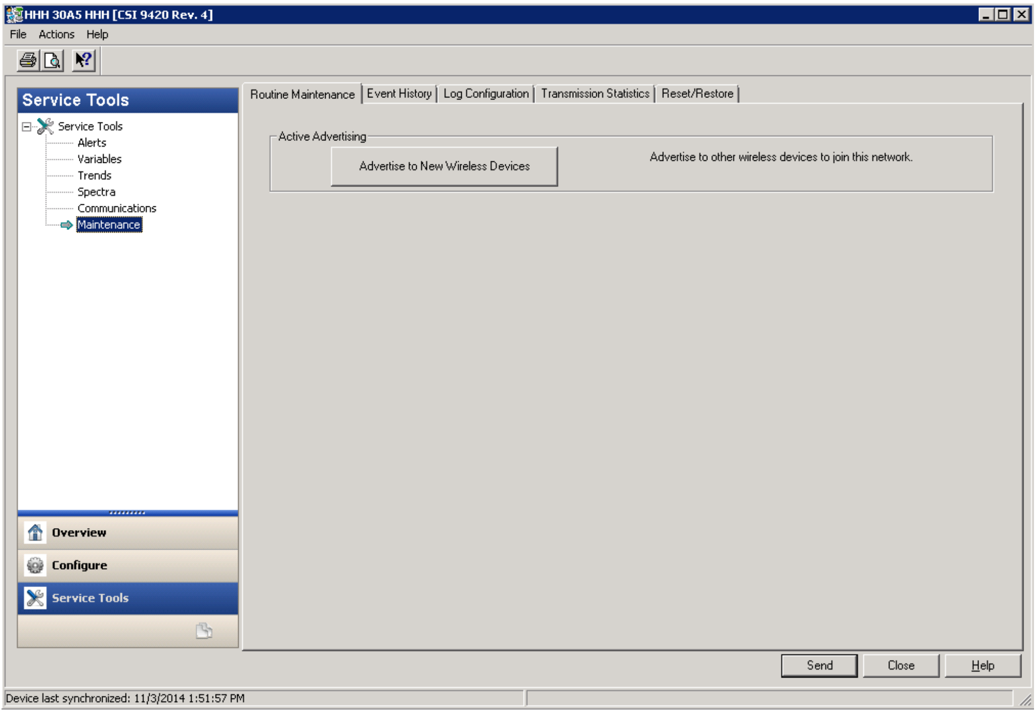


Click the Join Mode drop-down to select when the transmitter attempts to join a network.

Maintenance

Click Maintenance to manage the device maintenance and log settings.

Figure 2-38: Maintenance



Click Routine Maintenance tab > Advertise to New Wireless Devices to enable the gateway to search for new wireless devices on the network. This helps new devices join the network faster.

Click the Event History tab to display transmitter events such as measurements, HART transmissions, and wake actions.

Click the Log Configuration tab to configure event logging options. Data from event logs are useful during a debug process.

Click the Transmission Statistics tab to display statistics related to radio transmission operation such as communication interval between data requests.

Click the Reset/Restore tab to reset the device or to restore factory default settings.

2.4 Configuration with AMS Machinery Manager

AMS Machinery Manager can change the data acquisition settings for CSI 9420 devices. If the device is not commissioned in a HART DCS host (DeltaV or Ovation), you can allow AMS Machinery Manager to configure settings to provide easier access. You need to configure MHM Access Control in AMS Device Manager or in a Field Communicator to allow AMS Machinery Manager to make configuration changes to the CSI 9420.

If the device is commissioned in a HART DCS host, manage the configuration completely within the DCS. The DCS will generate an alert if you change the configuration externally. For more details on how to change the configuration from AMS Machinery Manager, refer to the Data Import topics in AMS Machinery Manager Help.

For device configurations managed by the DCS, you can still set independent alerts in AMS Machinery Manager to allow you to get a notification without going to the DCS operator (for example, you can set an alert at a lower threshold within AMS Machinery Manager).

If the primary HART host is AMS Device Manager, you can manage all alert configurations and device update rates from AMS Machinery Manager. The independent alert levels are still possible (for example: a different alert level in AMS Machinery Manager than in AMS Device Manager). In this scenario, you have direct access to both settings. The HART alerts are stored in the device and appear in AMS Device Manager and Alert Monitor. AMS Machinery Manager alerts only appear when you are using the AMS Machinery Manager software. This type of configuration is also acceptable if the DCS or PCS host is using Modbus or OPC and not HART.

⚠ CAUTION!

If the CSI 9420 devices are commissioned and installed on a HART DCS or PCS that is managing and archiving device configuration information, AMS Machinery Manager should NOT be used to change the configuration. This will cause an alert in the DCS due to the mismatch. The configuration may even be overwritten by the DCS, which can cause confusion.

2.4.1 Advanced Diagnostics application

The Advanced Diagnostics application is a licensed feature available in CSI 9420 devices. Contact your Emerson Sales Representative or Product Support for additional details.

When this feature is enabled, you can view a compressed thumbnail spectrum from a HART host, such as DeltaV or AMS Device Manager. The primary application however, is for integration with AMS Machinery Manager.

This feature allows you to retrieve compressed thumbnail spectra, high-resolution spectra, and analytical waveforms from the CSI 9420 and archive them in the AMS Machinery Manager database. This energy band provides additional insight, over and above the trended scalar values. This information provides a better indication of whether or not there is a real problem and, if so, how severe the problem is. By using the energy band, you can determine whether or not the vibration energy is periodic and at what frequency it is occurring.

Other configurable parameters for the energy band include:

- **Effective Fmax for the thumbnail spectrum** — For the velocity thumbnail spectrum, AMS Machinery Manager uses 100% as the default Fmax.
- **True Fmax for PeakVue** — This allows the monitoring of a slower machine with PeakVue. Choosing 1000 Hz Fmax uses about 1.6 seconds of data to produce a 1000 Hz analytical spectrum. Choosing 500 Hz Fmax uses about 3.2 seconds of data to produce a 500 Hz analytical spectrum. The 1000 Hz Fmax is better for 1800–3600 RPM machines. The 500 Hz Fmax is better for slower machines.

  Note

  True Fmax for PeakVue can only be configured in AMS Machinery Manager (MHM Access Control must first be enabled).

- **Averaging for the high-resolution velocity spectrum** — Averaging the velocity spectrum reduces the effect of transients in the data. If you use averaging, the frequency resolution of the high-resolution spectrum is 1.25 Hz/bin (800 lines) or 3 Hz/bin (400 lines). If you do not use averaging, the frequency resolution is 0.625 Hz/bin. The Fmax for all high-resolution spectra is 1000 Hz. 400-line averaging is enabled by default.

Data acquisitions can be on-demand, alert-based, or time-based. You can configure data acquisition settings in the AMS Machinery Manager Data Import program.

An on-demand spectrum (usually a thumbnail) provides a quick look at the vibration energy in the frequency domain. If you need more frequency resolution, you can obtain a high-resolution spectrum or a waveform. You can store data in AMS Machinery Manager database if the point is mapped.

You can configure time-based data acquisitions once; it happens automatically thereafter. You can define the type of data to collect (compressed spectrum, high-resolution spectrum, or waveform) and how often to collect and store data in the AMS Machinery Manager database. AMS Machinery Manager automatically stores all time-based data retrieved for future viewing and analysis.

With Alert-based data acquisitions, overall vibration and PeakVue measurements are processed to determine the alert state of the equipment being monitored. Then you can select at what alert level to trigger retrieval of the spectrum or waveform associated with that sensor. Alert-based data acquisition typically results in a longer life for your Smart Power Module.

Notes

- It is not necessary to transmit both waveform and spectrum from the CSI 9420. The spectrum is about half as much data to transmit as a waveform. If you need the waveform, the spectrum does not have to be transmitted because the software calculates the spectrum from the stored waveform.
- When using a power module, use care when configuring time-based retrieval of energy band. Transmitting high-resolution spectrum or waveforms consumes more energy and reduces the life of the power module.

When using a power module, the maximum recommended time-based acquisition rates are:

- Thumbnail spectrum — Once per day
- High-resolution spectrum — Once every two weeks
- Waveform — Once per month

On-demand data collection is not expected to have a significant impact on power module life. If you are using a power module, keep in mind that even on-demand acquisitions can have an adverse effect on the power module life if you request data, especially high-resolution data, too frequently.

For more information on these data acquisitions, refer to the Data Import topics in AMS Machinery Manager Help.

Enable Advanced Diagnostics application (standard)

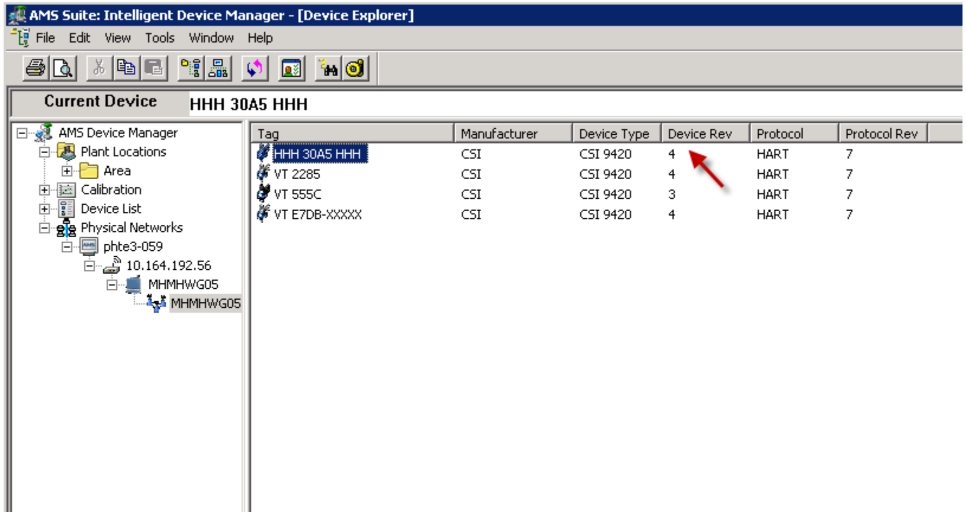
You can remotely upgrade an installed CSI 9420 that is already part of a wireless mesh network using either AMS Wireless Configurator or AMS Device Manager. There is no need to walk to the device or remove it from the field.

Notes

- If your CSI 9420 is not yet installed in the field, refer to *Enable Advanced Diagnostics application (alternative)* for instructions on how to perform the upgrade using a HART modem or a 375 or 475 Field Communicator.
- If you purchased an Emerson Smart Wireless Gateway, an installation DVD for AMS Wireless Configurator should have been included in your shipment. Otherwise, contact Product Support.

1. In AMS Device Manager, select the CSI 9420 device that you want to configure.
2. Verify that the device is Rev 4.

Figure 2-39: Verify device revision



Note

If you have an older device revision, a factory upgrade may be possible in some cases. Contact Product Support for more information.

3. Right-click the CSI 9420 device and select Configure.
4. From the Configure window, select Current from the Time drop-down menu.
5. Click Manual Setup > License tab > Configure License.
6. Select Yes to enable the Advanced Diagnostics application.

   This displays the serial number and request number. Call or email Product Support and provide this information. Product Support will issue a registration key.
7. Enter the registration key and click Next.
8. Click Finish when done.

Enable Advanced Diagnostics application (alternative)

If your CSI 9420 is not installed on a wireless network, you can perform the upgrade using either a HART modem or a 375 or 475 Field Communicator.

⚠ WARNING!

The hazardous area rating available with the CSI 9420 does not permit either of the following operations to be performed in a hazardous area. Do NOT open the device and connect to the wired HART terminals in a hazardous area without taking the appropriate safety precautions required by local, national, or international regulations.

Note

Connecting directly to the wired HART terminals on the CSI 9420 temporarily takes the device off of the wireless network. If in range, it automatically rejoins the wireless network after the wired connection is removed.

Method 1 - Using a wired HART modem

1. Launch AMS Device Manager.
2. Connect the CSI 9420 to an AMS Device Manager PC directly using a HART modem.
3. Follow the steps in *Enable Advanced Diagnostics application (standard)*.

Method 2 - Using a 375 or 475 Field Communicator

1. Use the lead set to connect the Field Communicator to the CSI 9420 terminal block.
2. Power on the Field Communicator, and select HART Application from the main menu.

   Depending on the Device Descriptor (DD) file in your CSI 9420, you may get a warning message. Click CONT to proceed to the main menu.
3. Select Configure or press 2 on the keypad.
4. Select Manual Setup or press 2 on the keypad.
5. Select License or press 6 on the keypad.
6. Select Configure License or press 2 on the keypad.
7. Select Yes or press 1 on the keypad.

   This displays the serial number and request number. Call or email Product Support and provide this information. Product Support will issue a registration key.
8. Enter the registration key in the space provided and press ENTER.

2.4.2 CSI 9420 Data Collection: Overview

Data collection on the CSI 9420 includes taking an acquisition and storing it in memory where it is available to be transmitted. AMS Machinery Manager obtains data from a CSI 9420 through the Data Import Server communication to the gateway device. You can view or change data collection settings through AMS Machinery Manager, in the Data Import program. You can set up policies and fine-tune your data collection based on time or alerts.

To make changes to a CSI 9420, AMS Device Manager settings must allow AMS Machinery Manager to make changes.

Note

In some cases, if the gateway device is connected to a HART host such as DeltaV, any changes made using the AMS Machinery Manager software will be rejected. In such cases, contact your DeltaV administrator or an instrument technician who is authorized to make the required configuration changes.

Alert-based data collection (Enable Store on Alert)

When you chose an alert-based data collection, overall vibration and PeakVue measurements are processed to determine the alert state of the equipment being monitored. Then you can select at what alert level to trigger retrieval of the spectrum or waveform associated with that sensor. Alert-based data collection typically results in a longer life for your Smart Power Module.

Time-based data collection (Disable Store on Alert)

When you choose time-based data collection, you can store waveforms, high-resolution spectra, and thumbnail spectra are requested on a timer. The same information is collected periodically without regard to the device's alert status. Time-based data collection typically shortens the life of your Smart Power Module.

CSI 9420 Publishing Policy

The Data Import program provides an easy credit-based system to control how often data is collected and transmitted from each of your CSI 9420 transmitters. You can collect on-demand acquisitions without impacting the CSI 9420 Publishing Policy.

On-demand acquisitions

When you collect on-demand acquisitions you do not impact the CSI 9420 Publishing Policy. Time-based or Alert-based acquisition requests will continue according to the acquisition parameters for that device. All acquisitions, however, impact the life of your Smart Power Module.

2.4.3 CSI 9420 publishing policy

The CSI 9420 publishing policy is a credit-based system to control automated data requests and publishing rates. It helps you easily limit data traffic and data collection on your CSI 9420 transmitters. For CSI 9420 transmitters with a Smart Power Module, a publishing policy also helps extend the life of the power module by limiting the data collection and publishing. The publishing policy does not prevent on-demand readings. You can collect an on-demand reading from the CSI 9420 at any time.

The publishing policy may help if you have many transmitters and have some of the following concerns:

- You want to conserve the life of your Smart Power Module.
- You may have a control environment.
- You want to limit how often you request data.

- You want to limit how often you collect and store data.

Consider the following example in which a CSI 9420 is configured for a 60 minute update rate and to request the PeakVue spectrum whenever the PeakVue value exceeds 10 g's. If the measurement stays above 10 g's for an extended period of time, AMS Machinery Manager, without a publishing policy, would request a new spectrum with every measurement or once every hour. Each subsequent spectrum adds relatively little value in terms of diagnostic capability, but continues to consume power, which needlessly shortens the life of the power module. It also consumes unnecessary bandwidth, which might jeopardize the system's ability to retrieve pertinent diagnostic data from other devices. The default CSI 9420 publishing policy would restrict duplicate transmissions from this particular transmitter for two weeks. If the PeakVue level were still above 10 g at that time, then the publishing policy would permit the transmitter to send through an additional spectrum. This pattern would continue every 2 weeks until the issue is resolved.

How a publishing policy works

The publishing policy is based on gateway credits, device credits, and a polling interval. Credits are consumed by automated data collection based on the acquisition type. On-demand acquisitions do not consume credits. The credits are applied and used per polling interval. If the polling interval is too short, a device may send data too often, clog the network bandwidth, and run down the power module. Therefore, you should set the polling interval to the longest time period that is practical.

Table 2-9: Device credit consumption by acquisition type

Acquisition	Credit
Spectrum (time-based or alert-based)	1
Waveform (time-based or alert-based)	2
Spectrum or Waveform (on-demand)	0

You can determine if a device has consumed all of its credits by viewing the CSI 9420 device status. In Data Import, expand the Device Hierarchy to a CSI 9420, right-click the CSI 9420, and select Get Status. A status message at the bottom of the screen displays the date and time when the device will be eligible to collect data automatically.

Data storage and retrieval order with alert-based data collection

Combining a publishing policy with alert-based automated data collection provides more control over data collection, while ensuring you have the latest data when the conditions worsen. If more than one transmitter sends alerts at the same time, the requests are handled on a first come, first served basis. Newer transmitters (units with software rev 6.0 or higher) will retain the alert data in a protected memory buffer until it is retrieved by AMS Machinery Manager. For older transmitters (units with software below rev 6.0), AMS Machinery Manager will retrieve whatever data is contained in the transmitter's memory at the time the request is processed. Also, with a newer transmitter, if the condition gets worse while the data is waiting to be retrieved, the transmitter will update its stored data with the latest measurement due to the higher alert level.

How to apply a publishing policy

You can apply a publishing policy globally to a Data Import Server or individually to each gateway device.

- Apply a publishing policy to a Data Import Server to affect each gateway monitored by that server.
- Apply a publishing policy to one gateway device to affect only the CSI 9420 transmitters connected to that gateway device.

2.4.4 Maximum network size and publishing policy settings

The maximum network size for use with Emerson's Smart Wireless Gateway is defined in *Table 2-10*.

Table 2-10: Maximum network size

Number of wireless devices	Update rate (in seconds)
12	1
25	2
50	4
100	8+

You can have up to 100 CSI 9420 devices on a single gateway, as the HART variables (i.e. scalar values) never have an update rate faster than 60 seconds. The update rate is typically once every 60 minutes.

The maximum network size decreases as you add different types of wireless devices to your network and when you collect high-resolution data. For example, if 5 temperature transmitters are broadcasting at a 1 second update rate, you will be able to add fewer CSI 9420 devices on this gateway than if the network contained only CSI 9420 devices. When you collect high-resolution data from a CSI 9420, such as vibration spectra and waveforms, the network can accommodate fewer wireless devices.

AMS Machinery Manager controls spectrum and waveform collection. The software features a publishing policy that limits the amount of data broadcast from a single device or over a single gateway. *Figure 2-40* shows the menu to configure the publishing policy in the (Modbus) Data Import program. *Table 2-11* shows the recommended (default) publishing policy settings. The default settings allow only 4 devices to send a full set of diagnostic data in a 24-hour period and no device will send data more often than every two weeks. This ensures that diagnostic data does not compete with process data, and that no single device dominates the available bandwidth.

Figure 2-40: CSI 9420 publishing policy menu

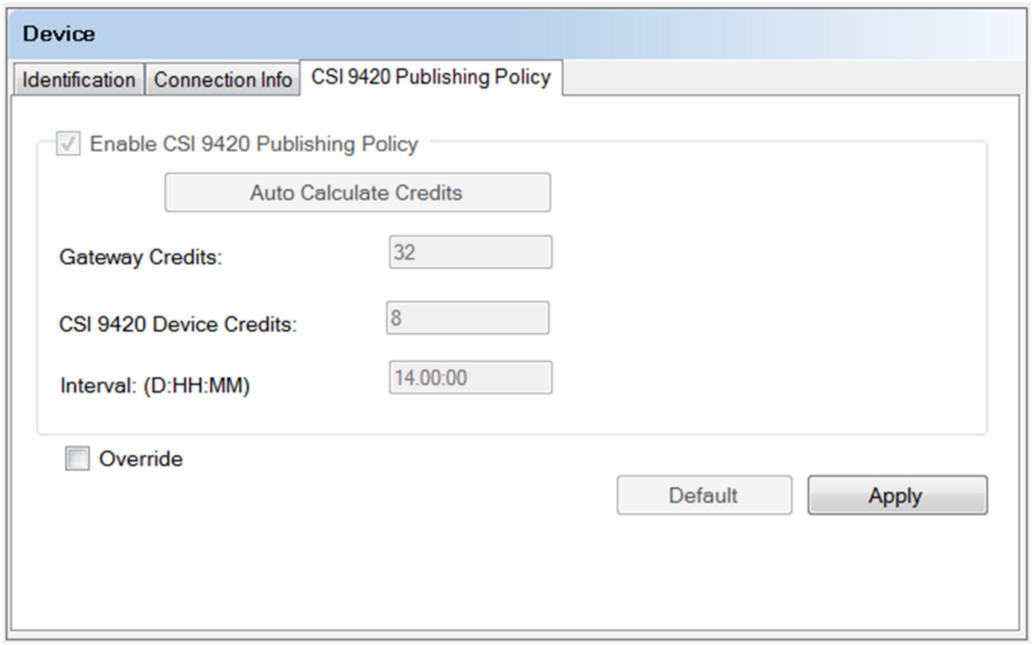


Table 2-11: Recommended (default) publishing policy settings

Network size	Interval (D.HH:MM)	Gateway credits	Device credits	Notes
N	N/4 days (but never less than 14.00:00)	N*8	8	High-resolution data limited only to 4 devices per day with most frequent collection interval of 2 weeks for 1-64 devices. After 64 devices, the collection interval increases to (N/4) days.

AMS Machinery Manager v5.61 features an auto-calculate button that populates the CSI 9420 Publishing Policy menu with default values shown in *Table 2-11*.

If a gateway is dedicated to vibration monitoring and will not be routing any process data, then you can customize the publishing policy to allow more diagnostic data to be collected. Follow these steps:

1. Use the settings in *Table 2-12* and *Table 2-13* to achieve the maximum network size as indicated.

Table 2-12: Maximum network size when collecting velocity and PeakVue spectra only (no waveforms)*

Network size	Interval (D.HH:MM)	Gateway credits	Device credits
12	1.00:00	48	4
25	3.12:00	100	
50	7.00:00	200	
100	30.00:00	400	

**Set-up for average velocity spectrum and PeakVue spectrum.*

Table 2-13: Maximum network size when collecting velocity spectrum and PeakVue waveform*

Network size	Interval (D.HH:MM)	Gateway credits	Device credits
12	1.00:00	72	6
25	3.12:00	150	
50	7.00:00	300	
100	30.00:00	600	

**Set-up for average velocity spectrum and PeakVue waveform.*

2. Set up efficient data collection as follows:

   - Use/create a well-formed network which conforms to best practices as described in the WirelessHART System Engineering Guide.
   - Collect an averaged spectrum for overall vibration (recommended). Do not collect the waveform used to calculate the overall vibration value in the device itself. Starting in AMS Machinery Manager v5.61, the spectrum can be 400 lines instead of 800 lines, which further increases the availability of bandwidth. If you require the waveform from overall vibration, you can collect it on demand.
   - For PeakVue, collect the waveform; the spectrum is always collected with the waveform. You need the waveform in order to use Auto-correlation to look for periodicity in the waveform. Auto-correlation helps you distinguish between impacting that is the result of under-lubrication or pump cavitation versus actual bearing damage.

2.4.5 Waveform or spectrum time

The amount of time required to get a waveform or spectrum varies significantly depending on the network size, network topology, and other installed applications competing for wireless bandwidth. Demand-based acquisitions use a special high-bandwidth mechanism that can transfer a 4096-point waveform in less than 5 minutes in optimum conditions, although it can take as much as 1 hour in fully loaded networks. Time-based acquisitions run at a lower bandwidth and typically take at least 30 minutes to acquire the same waveform.

Refer to the Data Import topics in AMS Machinery Manager Help for more details.

Energy Band trends

The transmitted thumbnail spectra, regardless of effective Fmax, also include Energy Band parameters which cover the entire frequency range. The Energy Bands for a 1000 Hz spectrum are:

- 0 Hz – 65 Hz
- 65 Hz – 300 Hz
- 300 Hz – 1000 Hz

The Energy Band parameters can only be trended in AMS Machinery Manager, and they are trended in the same way as the other scalar parameters. The device does not publish these values—requesting these wakes the device just like any other special data request.

Trend values are a good way to view on-demand data from your CSI 9420 powered by a Smart Power Module because these trend values come from the Smart Wireless Gateway's cache. Viewing on-demand trends does not cause the CSI 9420 to collect or transmit data as on-demand spectra and waveforms do.

The maximum (fastest) recommended storage rate for the Energy Band parameters is every 8 hours.

Refer to the Data Import topics in AMS Machinery Manager Help for more information.

3 Setup

Topics covered in this chapter:

3.1 Power the CSI 9420

Prerequisites

Install the Smart Wireless Gateway and ensure it is functioning properly before installing the CSI 9420 and all other wireless devices.

Procedure

1. Remove the transmitter back cover to access the power connections.
2. Provide power to the transmitter:

   - For the battery-powered version, plug in the power module.
   - For the externally powered version, connect a 10–28 VDC (24 V nominal) power supply to the bottom two screw terminals on the right.

   Note

   When selecting the power supply, note that each CSI 9420 has a peak current draw of 40 mA when awake and powering sensors.

3. Pull the wiring through the threaded conduit entry.

   Ensure that the grommet fits the wire properly and does not leak.

   Note

   The wire must snugly fit in the grommet feed-through in the cable gland to prevent ingress of water and other contaminants. If using one of the grommets for the standard low-power accelerometers, use a cable with a diameter between 0.125 to 0.250 in. (3.175 - 6.35 mm) to maintain a good seal. If a good seal is not possible with the wire selected, use an alternative grommet that provides a good seal.

Additional recommendations for power wiring:

- Install a Ferrite EMI filter inline with the wire to block electrical noise (included with package). Refer to *Section 6.1.3* for more information.
- Use 22 gauge or larger wiring (keep current requirements in mind when connecting multiple transmitters inline).

Tip
Power up wireless devices in order of proximity to the Smart Wireless Gateway, beginning with the closest device to the gateway. This results in a simpler and faster network installation.

3.2 Sensors

Each of the CSI 9420 signal inputs uses accelerometers to make vibration measurements. The term "sensor" applies to both an accelerometer and an accelerometer with embedded temperature. The CSI 9420 uses special low-power sensors to reduce power consumption and increase power module life. The sensor is available with or without embedded temperature.

3.2.1 Sensor operating limits

Table 3-1: Sensor operational ranges

Channel	DC bias range	DC input range	AC input range
Accelerometer 1	2–3 VDC	0–5 VDC	0.5–4.5 V (+/-80 g's peak)
Accelerometer 2	2–3 VDC	0–5 VDC	0.5–4.5 V (+/-80 g's peak)
Temperature 1	N/A	-40°C to 125°C	N/A

The accelerometers require a DC bias. The CSI 9420 provides the necessary bias and measures it to verify correct sensor operation. The nominal bias voltage is 2.5 V. If the bias voltage is outside of the 2–3 V range, the device generates a failed alert for the associated sensor. The DC input range represents the operational DC range of the signal input. The AC input range represents the operational AC range of the signal input.

3.2.2 Sensor handling

Note
Each sensor requires a standard 1/4–28-inch mounting location.

⚠ CAUTION!

Do not drop, hammer, or impact the sensor housing before, during, or after installation.

⚠ CAUTION!

Do not exceed the specified torque when tightening a stud-mounted sensor. Over-tightening a sensor will damage the sensing element and void the manufacturer’s warranty.

⚠ CAUTION!

Although the integral cable has a built-in strain relief, do not use excessive force when pulling the cable. Do not exert more than 5-lb of force directly on the sensor connection during installation. If possible, secure the cable to the machine near the point of sensor installation.

⚠ CAUTION!

Do not exert more than 5-lb pull force directly on sensor/cable connection during wire pulls.

For sensors that have been mounted before pulling the cable through the conduit or raceway to the CSI 9420, leave the cable bundled and secured to the machine. Permanent signal degradation takes place when cables are damaged. Do not step on, kink, twist, or pinch cables. Also take note of the placement of the cable bundle. Do not place bundles in a manner that may cause strain at the sensor/cable connection.

⚠ WARNING!

If the sensor is installed in a high-voltage environment and a fault condition or installation error occurs, the sensor leads and transmitter terminals could carry lethal voltages. Use extreme caution when making contact with the leads and terminals.

For high-voltage environments, attach the sensor leads first before connecting to a power source.

Tip

Use crimp-on ferrules or lugs to improve long-term reliability of sensor wiring.

3.2.3 Sensor mounting/attachment tools and supplies

Mounting tools

- Drill
- Spot face or end mill tool

The spot face tool attaches to a standard electric drill and provides a machined surface that is at least 1.1 times greater than the diameter of the sensor. The spot face tool also drills a pilot hole that can then be tapped for a stud mounted sensor.

You can purchase the spot face tool from Emerson (MHM P/N 88101), or you can substitute a spot face tool with similar characteristics as required. Contact your local sales representative for assistance.

Figure 3-1: Spot face or end mill tool

Attachment tools and supplies

- 40-200 inch-lb torque wrench with 1/8 in. hex bit

  Suggested vendor: Grainger (P/N 4YA74)

  Description: 3/8" drive inch-lb torque wrench. You can substitute with any torque wrench with a range of 40 to 70 inch-lb and less than 5 inch-lb increments.
- 1/4-28" taps and tap handle
- 9/16" open-end wrench
- 1/8" hex Allen key
- Wire brush
- Plant-approved cleaner/degreaser
- Plant-approved semi-permanent thread locker (e.g. Loctite)

For epoxy mount, you also need the following:

- 2-part epoxy (e.g. Loctite Depend [Emerson P/N A92106] or comparable)
- A212 Mounting Pads

Figure 3-2: A212 mounting pad

- (Optional) Grinder – to create a sufficiently flat mounting surface

3.2.4 Prepare the sensor mount

Stud mount (preferred)

Stud mount provides increased reliability, improved frequency response, and increased signal sensitivity.

Prerequisites

The mounting location must provide a flat surface of at least 0.5 in. (12.7 mm) in diameter and a case thickness exceeding 0.4 in. (10.2 mm). If this is not possible, use the epoxy mount method instead

Procedure

1. Prepare the spot face or end mill tool by setting the drill bit depth to a minimum of 0.325 in. (8.255 mm).
2. Using a wire brush and plant-approved cleaner, clean and degrease the surface area.
3. Keeping the spot face and end mill tool perpendicular to the machine surface, drill into the mounting location until the surface is smooth to the touch with no noticeable irregularities. This may require the spot face tool to remove as much as 0.04 in. (1.016 mm) or more from the surface.

Note

If the spot face is not uniform on all sides, it indicates that the spot face tool is not perpendicular to the mounting surface, and the resulting surface will not allow the sensor to be mounted properly. See *Section A.7* for illustrations of the correct milling process.

4. Using 1/4-28 in. tap set, tap a pilot hole to a minimum depth of 0.25 in. (6.35 mm).

   See *Section A.7* for an illustration of tapping a pilot hole.

Epoxy mount (alternative)

If it is not practical to drill into the machine casing, then the epoxy mount method is acceptable.

Procedure

1. If the equipment surface has a radius of curvature that is less than 4 in. (100 mm), grind a flat surface approximately 0.5 in. (12.7 mm) in diameter.
2. Using a wire brush and plant-approved cleaner, clean and degrease the surface area.
3. Using a 2-part epoxy (such as Emerson P/N A92106), spray the activator onto the mounting surface. Place a light coat of epoxy on the surface of the mounting pad and hold firmly against the machine spot face surface for 1 minute.

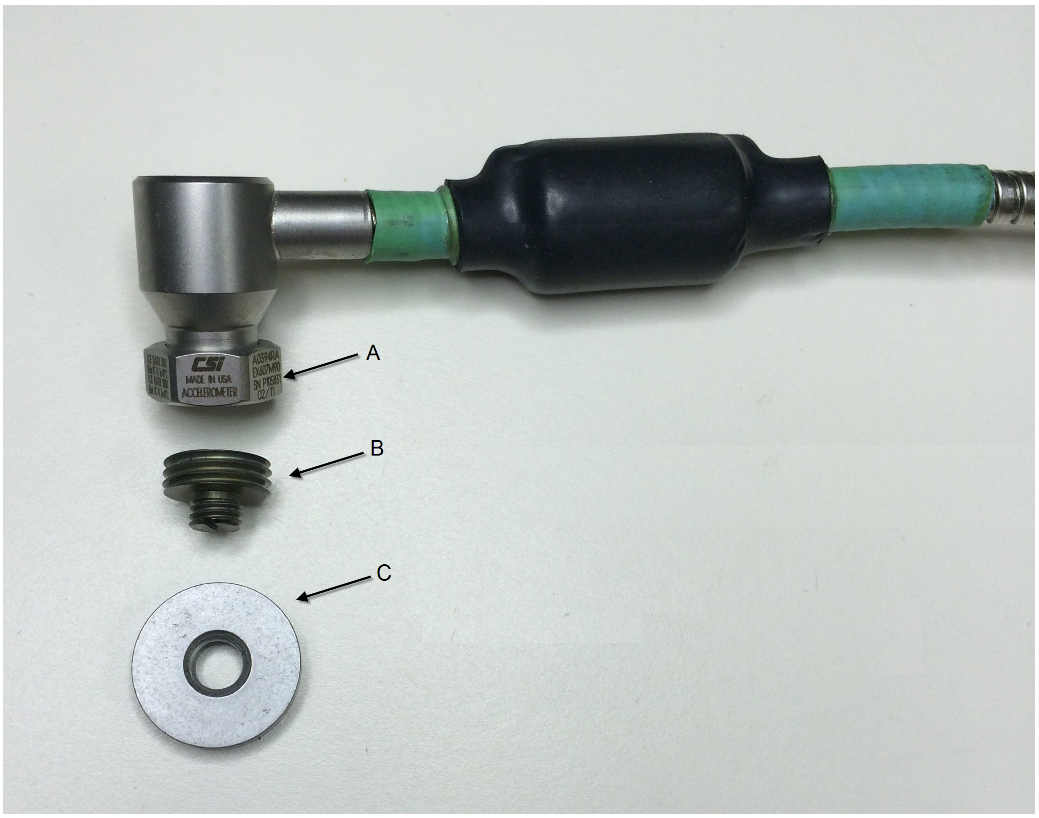
Note

If the adhesive does not set within 1 minute, it indicates that too much epoxy is applied or that the mounting surface is not prepared properly. Repeat steps 2–3.

3.2.5 Attach the sensors

Figure 3-3 shows a typical accelerometer, mounting stud, and mounting pad used with the CSI 9420. The mounting pad is only necessary when doing an epoxy mount.

Figure 3-3: Accelerometer, mounting stud, and optional mounting pad



A. accelerometer
B. mounting stud (included with the accelerometer)
C. mounting pad

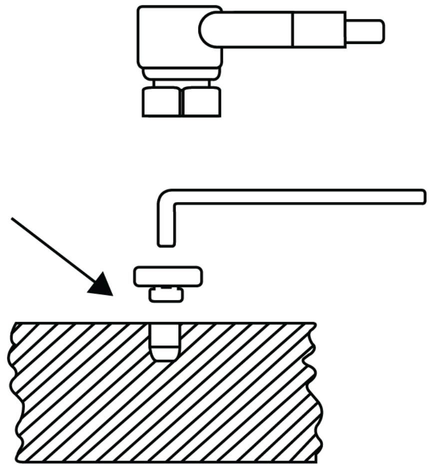
Prerequisites

Whenever possible, mount sensors to the machine while pulling cables. If you have to mount the sensor at another time, secure the bundled cable to the machine and protect it from damage.

Procedure

1. Using a plant-approved cleaner/degreaser, remove any lubricating fluid used during the tapping process and if necessary, clean the mounting stud threads.
2. Rub a small amount of semi-permanent thread locker onto the mounting location.

Figure 3-4: Apply thread locker onto mounting location

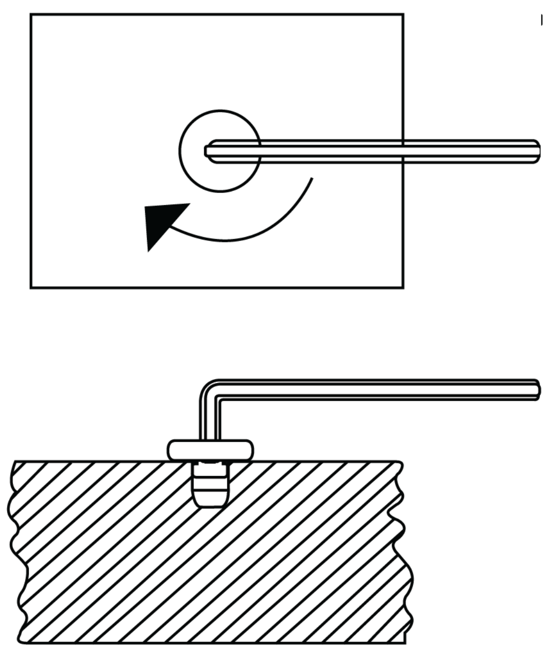


3. Using a 1/8 in. Allen key (English mounting stud) or a 4 mm Hex Allen key (metric mounting stud), loosely screw the mounting stud into the mounting location.

   The mounting location is the machine surface when using stud mount and the mounting pad when using epoxy mount.

4. Using a torque wrench with 1/8 in. hex bit, torque to 7–8 ft-lb (9.5–10.8 N-m) to tighten the mounting stud.

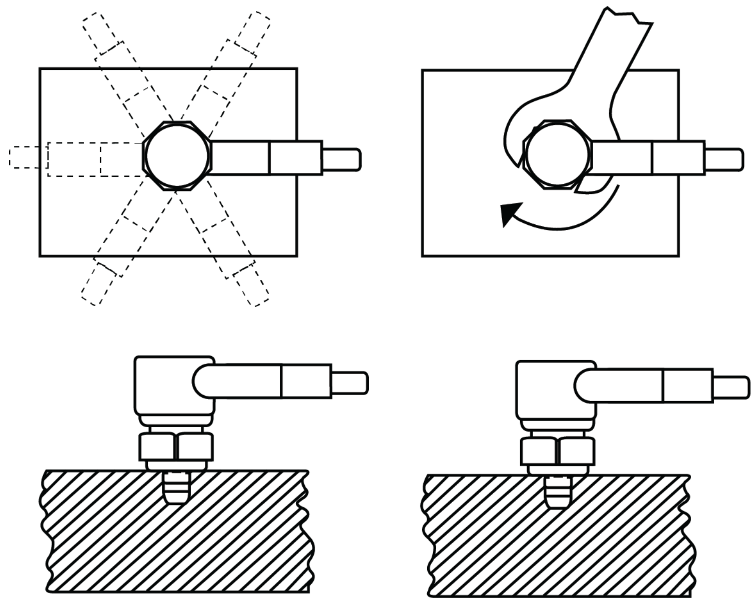
Figure 3-5: Tighten the mounting stud



For stud mount: If the mounting stud is still not seated against the spot face after you apply the correct torque force, it indicates that the tap hole is not deep enough. Remove the mounting and tap a deeper hole.

5. Apply a thin coat of semi-permanent thread locker to the threads on the sensor housing.
6. Place the sensor onto the mounting stud and hold it to create the least amount of cable strain and cable exposure. While holding the sensor, hand-tighten the 9/16 in. captive nut and use a torque wrench with 9/16 in. open end to finish tightening to 2–5 ft-lb (2.7–6.8 N-m).

Figure 3-6: Hand-tighten the captive nut



If the mounting stud does not disengage from the sensor, use a flathead screwdriver to hold the stud and turn the hex nut counter-clockwise with a wrench.

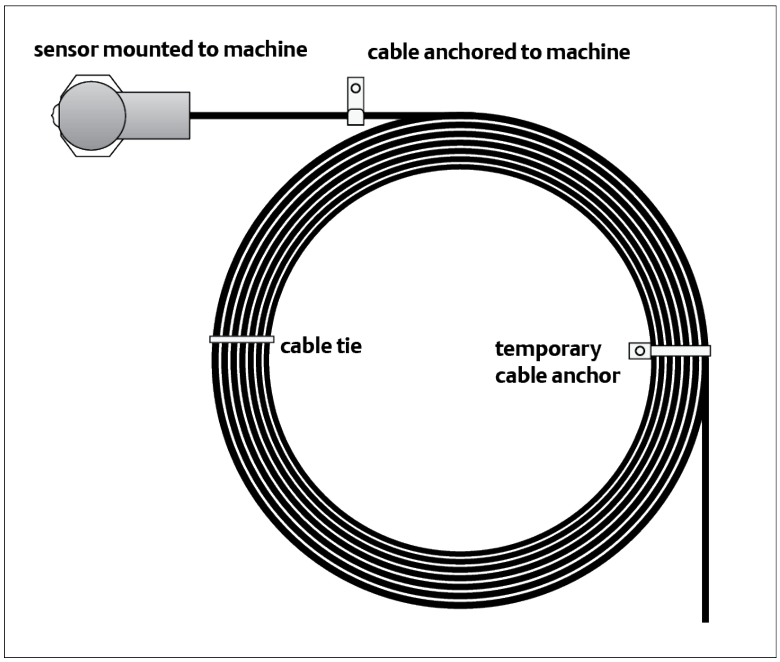
3.2.6 Secure the sensor cables

⚠ WARNING!

All wiring should be installed by a trained and qualified electrician. Wiring must conform to all applicable local codes and regulations. Follow local codes and regulations regarding wire type, wire size, color codes, insulation voltage ratings, and any other standards.

Using an appropriately sized cable clamp, secure the sensor cable to the machine approximately 4–5 in. (100–125 mm) from the mounting location. Do not curl into a bending radius of less than 2.8 in. (71 mm).

Figure 3-7: Securing a cable with temporary cable anchor



If the pulling of cables is not currently scheduled, secure the bundled sensor cables so that no strain is placed on the integral sensor/cable connectors. Do not let the bundled cable hang from the sensors. Do not place cables on plant floors, maintenance access areas, and/or footholds that may cause damage to the cables.

3.2.7 Conduit installation guidelines

⚠ WARNING!

All wiring should be installed by a trained and qualified electrician. Wiring must conform to all applicable local codes and regulations.

- Adhere to IEEE 1100 specifications for grounding.
- Do not exceed a 40 percent fill for conduits.
- Route the conduit away from power trays using these guidelines:

6 in.	110 VAC
12 in.	220 VAC
24 in.	440 VAC

- Attach the conduit to the NPT threaded holes on the side of the CSI 9420.

3.2.8 Connect the sensors

⚠ WARNING!

If the sensor is installed in a high-voltage environment and a fault condition or installation error occurs, the sensor leads and transmitter terminals could carry lethal voltages. Use extreme caution when making contact with the leads and terminals.

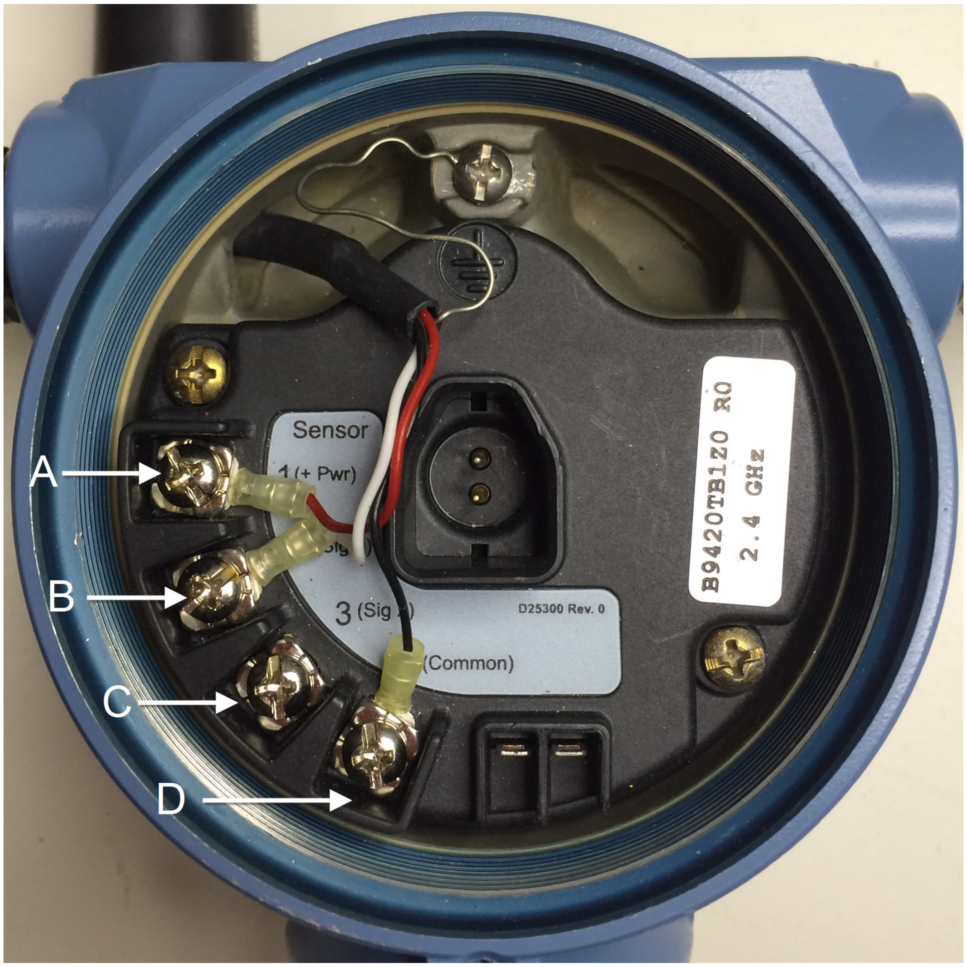
Procedure

1. Remove the transmitter back cover.
2. Attach the sensor leads. Follow the wiring diagram in *Figure 3-8* to connect one sensor, the wiring diagram in *Figure 3-9* to connect two sensors, and the wiring diagram in *Figure 3-10* to connect one sensor with temperature.

Note

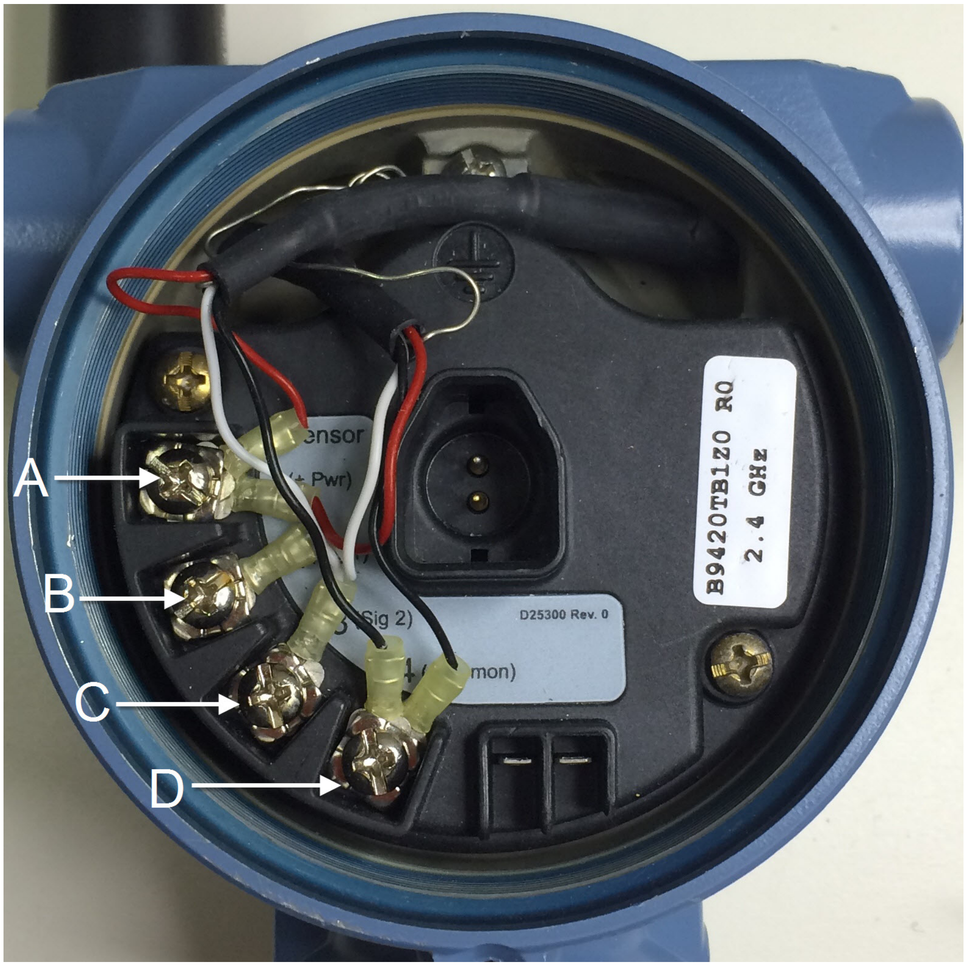
You can connect one or two accelerometers to the CSI 9420. You can connect only one accelerometer with a temperature sensor.

Figure 3-8: Connecting one sensor



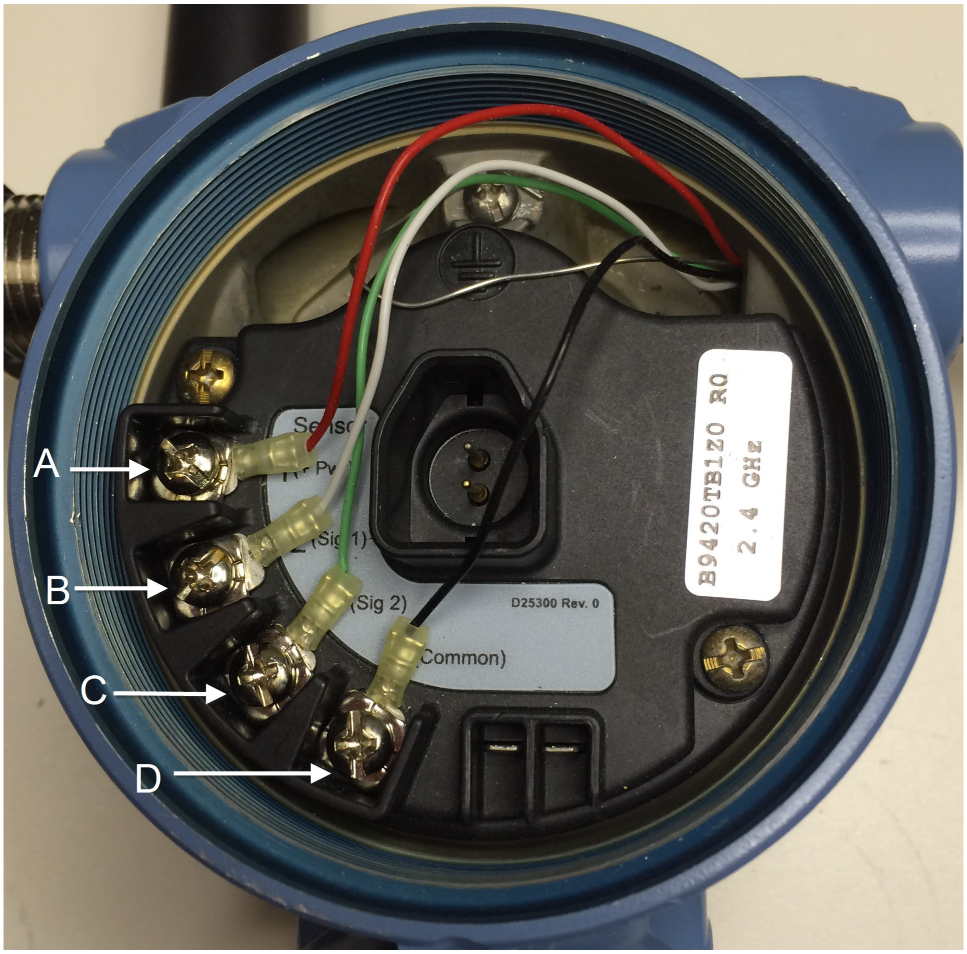
A. *Connector 1 – red wire*
B. *Connector 2 – white wire*
C. *Connector 3 – blank*
D. *Connector 4 – black wire*

Figure 3-9: Connecting two sensors



A. *Connector 1 – two red wires, one from each accelerometer*
B. *Connector 2 – white wire from one accelerometer*
C. *Connector 3 – white wire from other accelerometer*
D. *Connector 4 – two black wires, one from each accelerometer*

Figure 3-10: Connecting one sensor (accelerometer with temperature)



A. Connector 1 – red wire
B. Connector 2 – white wire
C. Connector 3 – green wire (temperature wire)
D. Connector 4 – black wire

3. Connect the power module or external DC power.
4. Verify the connection through the status on the LCD (if available).
5. Reattach and tighten the cover.

   Use a strapping wrench to tighten the cover until it will no longer turn and the black O-ring is no longer visible. This ensures that water, water vapor, or other gases do not penetrate into the housing.

Note

You can use crimp-on ferrules or lugs to improve long-term reliability of sensor wiring.

3.3 Liquid Crystal Display (LCD)

Note

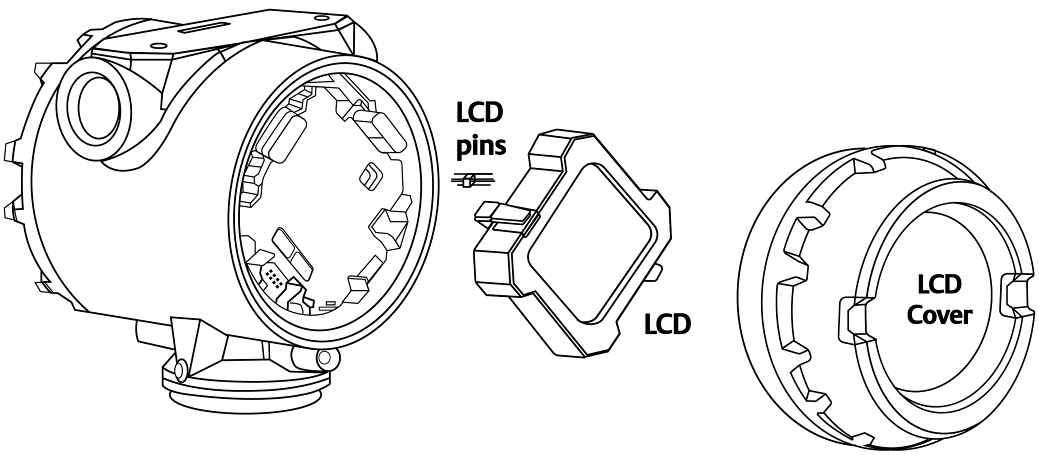
If you purchased the CSI 9420 without the optional LCD, and you want to add an LCD, an upgrade kit is available (P/N A9400LCDM, A9400LCD-SS, or 00753-9004-0002). Contact Product Support for more information.

3.3.1 Install the LCD

⚠ WARNING!

While you can perform this modification for either CSI 9420 devices that are certified as intrinsically safe, for non-rated CSI 9420 devices that carry no hazardous area certification, or for CSI 9420 devices that are certified as non-incendiary (e.g. Class I, Div 2 or Zone 2 rated), only an Emerson Product Service Center personnel should remove and reinstall the LCD . Failure to do so may void the hazardous location certification.

Figure 3-11: Installing the LCD



Procedure

1. Remove the LCD cover.

   ⚠ CAUTION!

   The front electronics end cap (the cap covering the LCD) is certified for Class I, Division I in appropriate gas environments (check the nameplate on the device for details).

   Exposing the electronics to a production environment may allow particulates, moisture, and other airborne chemicals to enter into the device, which could lead to contamination and potential product performance issues.

2. Insert the four-pin connector into the interface board, rotate the LCD to the correct position, and snap the LCD in place.

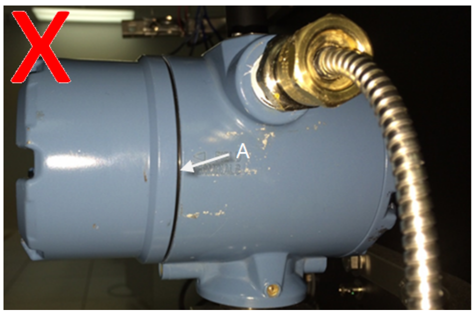
If the LCD pins are inadvertently removed from the interface board, carefully re-insert the pins before snapping the LCD in place.

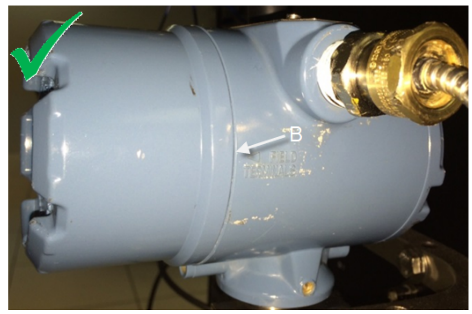
After installation, you can remove the LCD by squeezing the two tabs and pulling gently. You can then rotate it in 90-degree increments and snap it back in place.

3. Attach the LCD cover.

   Use a strapping wrench to tighten the cover until it will no longer turn and the black O-ring is no longer visible.

Figure 3-12: Sealing the end cap





A. Improperly sealed end cap. Black O-ring is still visible.
B. Properly sealed end cap. Black O-ring is no longer visible.

Important

Moving one LCD around to multiple devices, on an "as need" basis, is NOT recommended. This can cause reliability problems over time. The connector pins on the LCD are not designed for repeated connect/disconnect.

3.3.2 Enable the LCD

When you enable the LCD, the CSI 9420 displays information about its network state and its measurements. This is helpful for configuration, installation, and commissioning. The LCD provides a visual indication on the status of the device and shows its current measurements.

Transmitters ordered with the LCD are shipped with the display installed but with the LCD disabled/turned off. You need to enable the LCD using a Field Communicator or using AMS Device Manager.

Enable the LCD using a 375 or 475 Field Communicator

1. Use the lead set to connect the Field Communicator to the CSI 9420 terminal block.
2. Turn on the Field Communicator.
3. Select Configure > Manual Setup > General Settings > LCD Mode > Periodic Display.

   Options available for LCD configuration include:

   - Not installed – Use this setting if the LCD is not installed.

- Periodic Display – Use this setting to show only relevant data. This setting does not extend the wake cycle.
- Troubleshooting Display – Use this setting when troubleshooting the transmitter.
- Off – Use this setting to disable the LCD.

Enable the LCD using AMS Device Manager

1. Launch AMS Device Manager and locate the network where the CSI 9420 is connected.
2. Right-click the CSI 9420 device and select Configure > Manual Setup.
3. Click the General Settings tab and from the LCD Mode drop-down menu, select Periodic Display.

   Options available for LCD configuration include:

   - Not installed – Use this setting if the LCD is not installed.
   - Periodic Display – Use this setting to show only relevant data. This setting does not extend the wake cycle.
   - Troubleshooting Display – Use this setting when troubleshooting the transmitter.
   - Off – Use this setting to disable the LCD.

Note

When operating the CSI 9420 with the Smart Power Module, disable the LCD in the transmitter configuration after installation to maximize power module life. While the LCD module itself consumes very little power, having it activated will alter the operating cycle of the transmitter in such a way that can impact the power module life by up to 15–20%.

3.3.3 Turn on the LCD

1. Remove the LCD cover.

   ⚠ CAUTION!

   The front electronics end cap (the cap covering the LCD) is certified for Class I, Division I in appropriate gas environments (check the nameplate on the device for details).

   Exposing the electronics to a production environment may allow particulates, moisture, and other airborne chemicals to enter into the device, which could lead to contamination and potential product performance issues.

2. Press the DIAG button to turn the LCD on.

   This displays the Tag name, Device ID, Network ID, Network Join Status, and Device Status screens.

3. Attach the LCD cover.

Use a strapping wrench to tighten the cover until it will no longer turn and the black O-ring is no longer visible. Refer to *Figure 3-12* for an illustration on how to properly seal the end cap.

3.4 Ground the transmitter

The transmitter operates with the housing, either floating or grounded. However, the extra noise in floating systems affects many types of readout devices. If the signal appears noisy or erratic, grounding the transmitter at a single point may solve the problem.

You can reduce electrostatic current in the leads induced by electromagnetic interference by shielding. Shielding carries the current to the ground and away from the leads and electronics. If the transmitter end of the shield is adequately grounded to the transmitter and the transmitter is properly grounded to the earth ground, very minimal current enters the transmitter.

If the ends of the shield are left ungrounded, a voltage is created between the shield and the transmitter housing, and between the shield and earth at the element end. The transmitter may not be able to compensate for this voltage, causing it to lose communication and/or generate an alarm. Instead of the shield carrying the current away from the transmitter, the current flows through the sensor leads and into the transmitter circuitry where it interferes with circuit operation.

Each accelerometer contains a drain wire that is connected to the sensor shield. This wire should be connected to the internal grounding screw attached to the housing near the terminal block.

Ground the transmitter in accordance with local, national, and international installation codes. You can ground the transmitter through the process connection, the internal case grounding terminal, or the external grounding terminal.

4 Operation and maintenance

Topics covered in this chapter:

- *Verify status and operation*
- *Power module maintenance*

4.1 Verify status and operation

Verify the status and operation of the CSI 9420 through the following:

- LCD
- Field Communicator
- Smart Wireless Gateway

LCD

If the LCD is installed and enabled, it should display the measured values at the configured update rate during normal operation.

Remove the front cover of the LCD and press the DIAG button to display the Tag name, Device ID, Network ID, Network Join Status, and Device Status screens and make measurements.

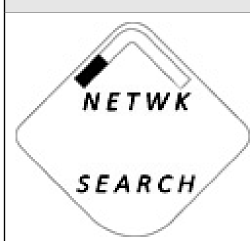
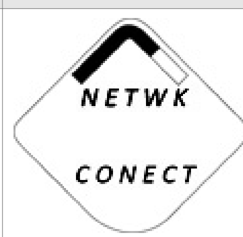
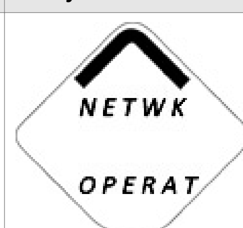
⚠ CAUTION!

The front electronics end cap (the cap covering the LCD) is certified for Class I, Division I in appropriate gas environments (check the nameplate on the device for details).

Exposing the electronics to a production environment may allow particulates, moisture, and other airborne chemicals to enter into the device, which could lead to contamination and potential product performance issues. In all cases, whenever opening the front end cap, be sure to seal it completely afterwards by tightening until the black O-ring is no longer visible.

Table 4-1 shows the LCD screens when the CSI 9420 connects to a network.

Table 4-1: LCD network status screens

Searching for network	Joining the network	Connected to the network	Operational and ready to send data
			

For more information on LCD screen messages, refer to *Appendix C*.

Field Communicator

You can verify the status of the CSI 9420 and configure it using a Field Communicator. Table *Table 4-2* shows the fast key sequences you can use to configure and connect the CSI 9420 to a network. See the *Section 2.2* and *Section 2.2.1* for more information on the Field Communicator menu trees.

Note

HART Wireless transmitter communication requires a CSI 9420 Device Descriptor file (DD). The DD is included on the DVD that came with the device. Refer to the Field Communicator User's Manual for more details on DDs or go to *http://www2.emersonprocess.com/en-US/brands/Field-Communicator/Pages/SysSoftDDs.aspx* for instructions on adding a DD for CSI 9420.

Table 4-2: Field Communicator fast key sequence - connecting to a network

Key sequence	Menu item
2, 2, 1 (Manual setup)	Network ID Broadcast Info Join Device to Network Configure Publishing Configure Update Rate Transmit Power Level Default Burst Config
2, 1(Guided setup)	Configure Sensors Configure Variable Mapping Configure Units Alert Limits Sensor Power Enable Join Device to Network Configure Publishing Configure Update Rate

Note

The CSI 9420 does not publish any data to the gateway while a Field Communicator or HART modem is attached to it. After removing the leads from the Field Communicator/HART modem, the CSI 9420 senses that this connection has been removed and resumes publishing data to the gateway; however, this process can take several minutes. Pressing the "CONFIG" button on the local operator interface (when the CSI 9420 is not already engaged in performing another task) forces the CSI 9420 to switch operating modes.

Smart Wireless Gateway

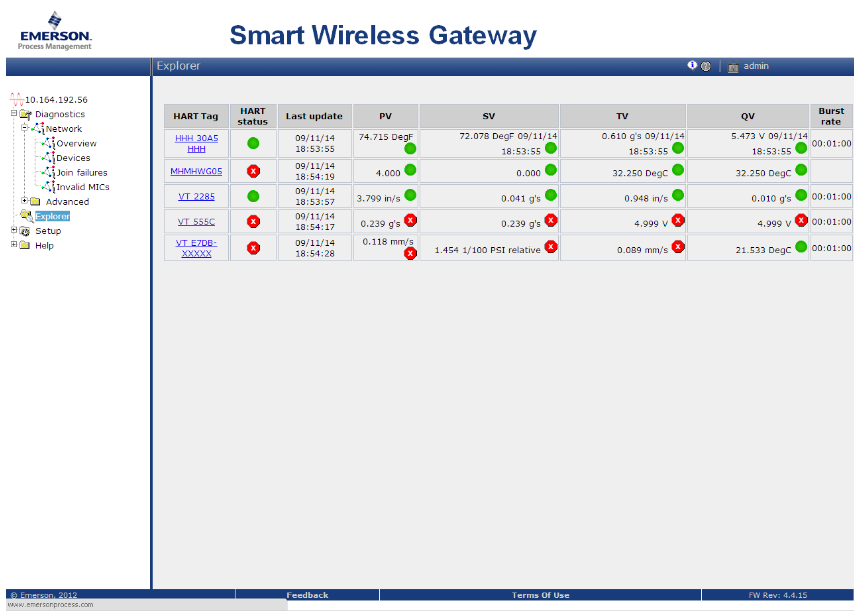
From the Smart Wireless Gateway web server, navigate to the Explorer page. This page shows if the device has joined the network and if it is communicating properly.

The Explorer page displays the transmitter tag name, PV, SV, TV, QV, time of last update, and update rate (burst rate). A green status indicator means that the device is working properly. A red indicator means there is a problem with either the device or its communication path.

Note

It is normal for the CSI 9420 to have a red "X" on the screen until the sensor is installed.

Figure 4-1: Smart Wireless Gateway



Click on a tag name to display more information about the device.

If the CSI 9420 is configured with the Network ID and Join Key, and sufficient time for network polling has passed, the transmitter will then be connected to the network.

The most common cause of incorrect operation is that the Network ID or Join Key are not set correctly in the device. The Network ID and Join Key in the device must match those found on the Smart Wireless Gateway. From the Smart Wireless Gateway, click Setup > Network > Settings to display the Network ID and Join Key. Make sure the setting for "Show join key" is set to Yes.

4.2 Power module maintenance

The Smart Power Module contains two “C” size primary lithium/thionyl chloride cells. Each cell contains approximately 2.5 grams of lithium, for a total of 5 grams in each pack.

Actual power module life can vary dramatically based on operating parameters—including whether high-resolution data such as vibration waveforms and/or spectra are being retrieved from the device.

Handling

Under normal conditions, the power module materials are self-contained and are not reactive as long as the batteries and the power module pack integrity are maintained. Take care to prevent thermal, electrical, or mechanical damage. Protect the contacts to prevent premature discharge.

⚠ CAUTION!

Use caution when handling the power module pack. The power module pack can be damaged if dropped from heights in excess of 20 feet.

⚠ WARNING!

Power module hazards remain even when cells are discharged.

Environmental considerations

As with any battery, consult local, national, and international environmental rules and regulations for proper management of spent batteries. If no specific requirements exist, you are encouraged to recycle through a qualified recycler. Consult the materials safety data sheet for power module-specific information.

Replacement

When the power module needs to be replaced, remove the power module cover and the power module pack. Replace the pack (P/N MHM-89002, Rosemount P/N 00753- 9220-XXXX, or Rosemount Model # 701PBKKF) and replace the cover. Tighten to specifications and verify the operation.

Shipping

The unit is shipped without the power module installed. Unless you are specifically instructed to do otherwise, always remove the power module pack from the unit prior to shipping.

The U.S. Department of Transportation, International Air Transport Association (IATA), International Civil Aviation Organization (ICAO), and European Ground Transportation of Dangerous Goods (ADR) regulate the transportation of primary lithium batteries

The shipper is responsible for complying with these or any other local requirements. Consult current regulations and requirements before shipping.

5 Velocity, PeakVue, and temperature

Topics covered in this chapter:

- *Overall Velocity*
- *PeakVue*
- *Temperature*

5.1 Overall Velocity

The Overall Velocity measurement provides a summation of the low-frequency vibration energy, which indicates fault conditions such as imbalance, misalignment, looseness, and late-stage bearing problems.

The CSI 9420 uses (lower-frequency) Overall Velocity in conjunction with (higher-frequency) PeakVue to provide a holistic solution across all frequencies while optimizing the usage of the limited power and bandwidth available in a wireless device. The majority of developing fault conditions manifest in one or both of these key parameters.

The difference between the standard vibration waveform and the associated PeakVue waveform is shown in *Figure 5-1* and *Figure 5-2*. Overall Vibration indicates energy from shaft rotation, expressed in units of RMS velocity per the ISO 10816 standard. PeakVue, on the other hand, filters out the rotational energy to focus on impacting. Impacting is expressed in units of Peak acceleration. This indicates key mechanical problems such as rolling element bearing faults, gear defects, and under-lubrication.

Figure 5-1: Velocity waveform

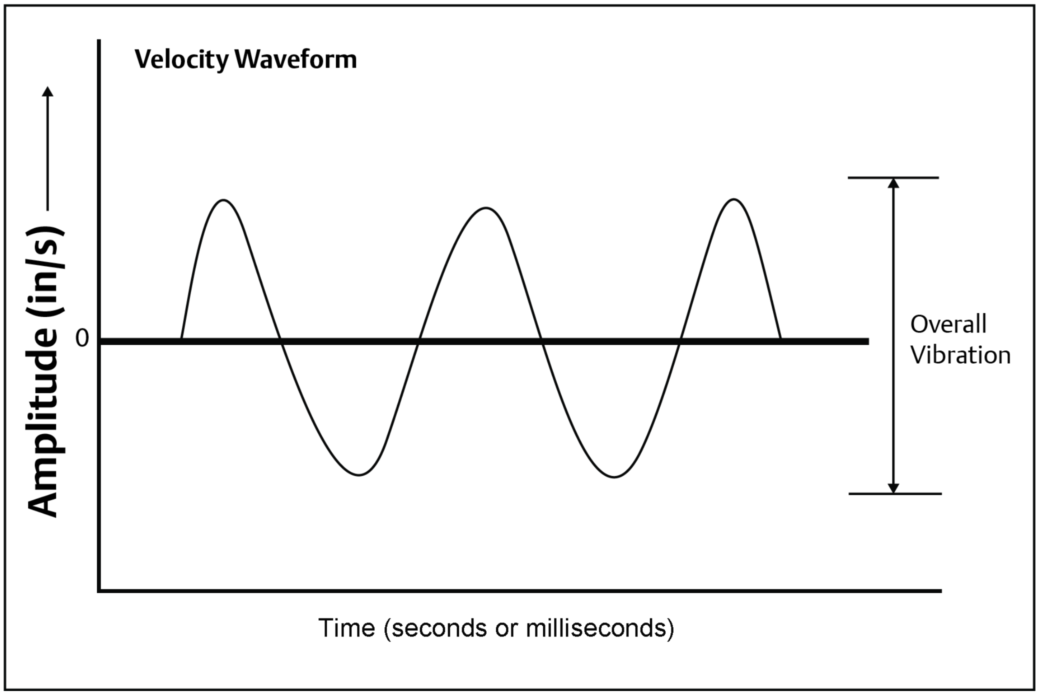
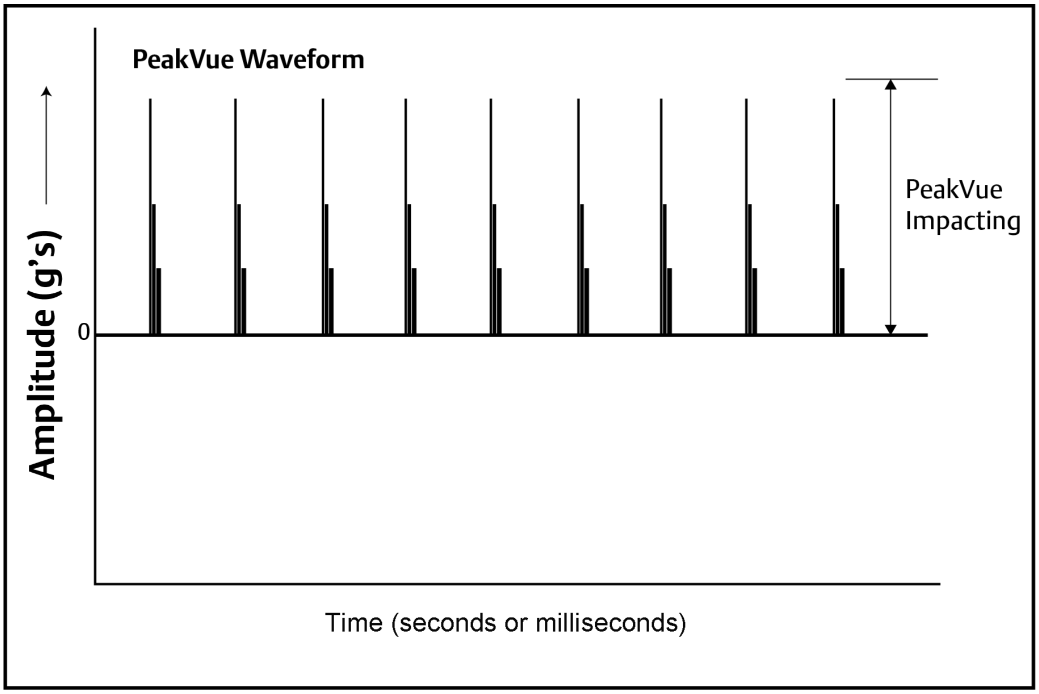


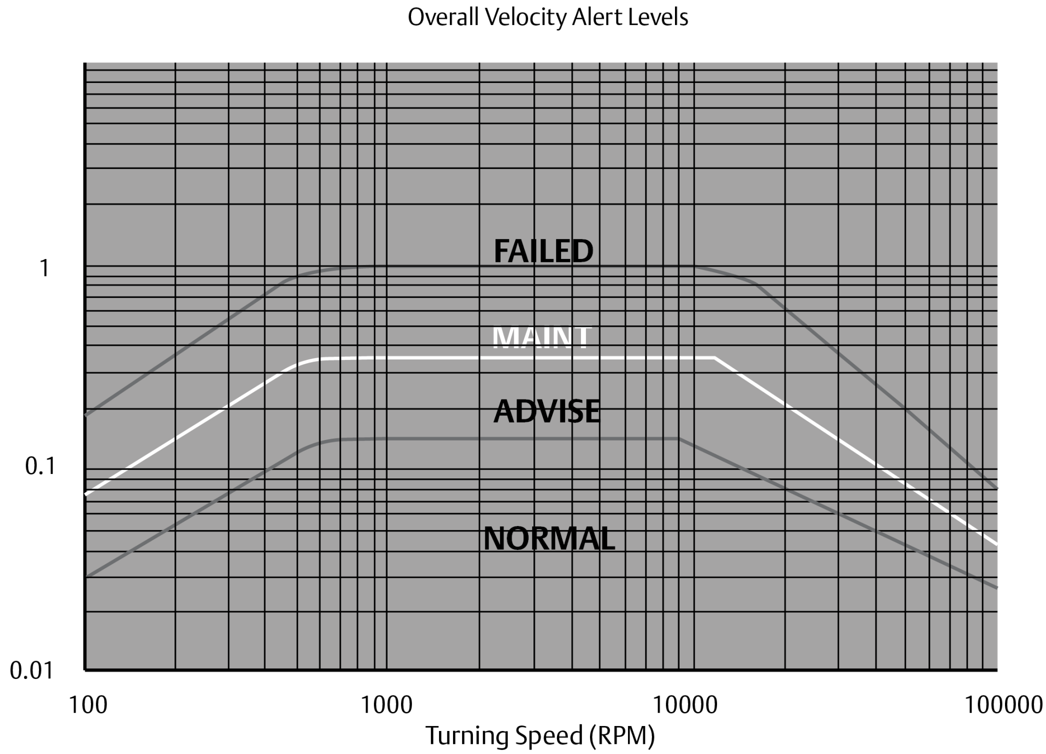
Figure 5-2: PeakVue waveform



While PeakVue is very useful for providing an early indication of impact-related faults in rolling-element bearings, there are many general applications where a lower-frequency measurement is more appropriate. Also, virtually all vibration analysts are very familiar with the Overall Velocity measurement and use it as part of their existing vibration programs. While it may not be possible to obtain a measurement result comparable to the PeakVue value reported by the CSI 9420 with a non-CSI handheld vibration analyzer, the Overall Velocity measurement is common throughout the industry and should be easy to correlate with results from handheld instruments.

There are, however, a number of different methods for measuring and reporting Overall Velocity, so ensure that the measurement conditions are similar when trying to duplicate the value reported by the CSI 9420 with a handheld. The CSI 9420 uses ISO 10816, which defines a measurement bandwidth of 2 Hz to 1 kHz. The ISO 10816 general fault levels at various turning speeds are shown in *Figure 5-3*.

Figure 5-3: General fault levels



Depending on the type of machine being monitored, the values shown in this graph should be multiplied by the service factors given in *Table 5-1*.

Table 5-1: Service factor multiplier

Machinery type	Service factor
Single-stage Centrifugal Pump, Electric Motors, Fans	1.0
Non-critical Chemical Processing Equipment	1.0

Table 5-1: Service factor multiplier *(continued)*

Machinery type	Service factor
Turbine, Turbine Generator, Centrifugal Compressor	1.6
Miscellaneous Equipment	2.0

Figure 5-3 shows the Overall Velocity thresholds for root-mean-square (RMS) velocity in units of inches per second. Particularly, in digital acquisition systems, it is customary to measure and calculate with RMS quantities. While it is accepted practice in the industry to convert between RMS and peak values using the 1.4142 conversion factor, it is not technically correct to do so except for a pure sinusoidal waveform. For this reason, the CSI 9420 measures, calculates, and reports Overall Velocity in RMS, and it is necessary to multiply by 1.4142 to get the corresponding peak levels if this is the preferred format.

Table 5-2: Default velocity levels in CSI 9420

Alert level	Velocity (in RMS)
Advise	0.14 in/s
Maintenance	0.35 in/s
Failed	1.0 in/s

5.2 PeakVue

PeakVue™ is a patented Emerson technology that is very useful for isolating high-frequency phenomena associated with developing faults, especially in rolling-element bearings.

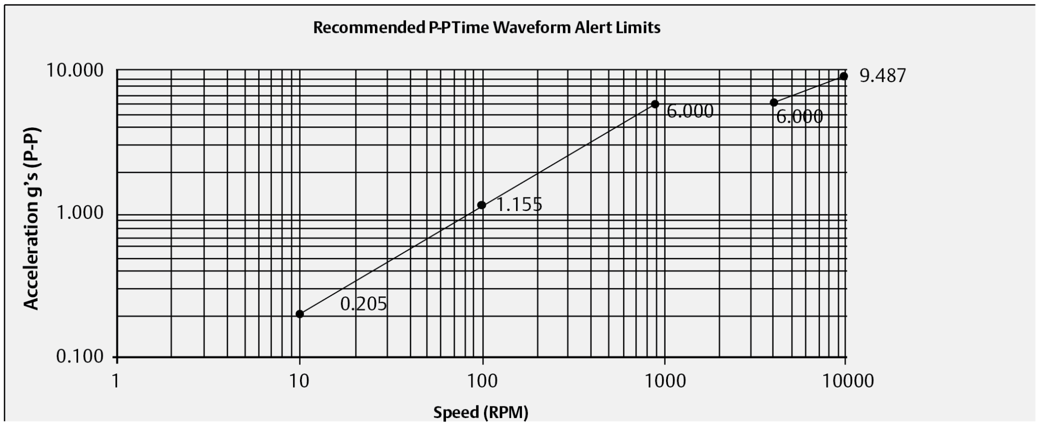
The premise for PeakVue is that the high-frequency components are not readily detected with more conventional measurements such as Overall Velocity, low-frequency energy (LFE), or digital overall. This is because the low-frequency measurements either average the energy or provide an energy summation over a relatively large frequency band, and the relative amount of energy that is typically contributed by the high-frequency components is quite small. As a result, even large "spikes" are difficult to detect with classic techniques.

The difference in the vibration waveform and the associated measurement for overall vibration versus PeakVue is shown in *Figure 5-5* and *Figure 5-6*. The overall vibration is well below the established advisory and maintenance alert levels indicating that the machine is running well. In contrast, the PeakVue graph shows that the values have increased from zero, and that they are already crossing the advisory alert level and approaching the maintenance alert level. This early warning about impending defects is key to maintaining good machine health.

The PeakVue algorithm isolates the peak energy of interest to provide early indications of developing bearing faults such as inner and outer race defects, ball defects, and lubrication problems. Any type of "impacting" fault, where metal is contacting metal, is readily visible with PeakVue long before there is any significant increase in Overall Vibration. PeakVue is especially useful for monitoring rolling-element bearings.

Figure 5-4 shows an example of a typical formula for calculating the advisory alert level for PeakVue.

Figure 5-4: PeakVue advisory levels



These are the equations that govern this curve:

$$g's = \left(\frac{RPM}{900}\right)^{0.75} \times 6 \text{ for } RPM < 900$$

$$g's = 6, \qquad \text{for } 900 < RPM \leq 4000,$$

$$g's = \left(\frac{RPM}{4000}\right)^{0.5} \times 6 \quad \text{for } 4000 < RPM \leq 10000,$$

$$g's = 10, \qquad \text{for } RPM > 10000,$$

These, however, are generic limits. They are provided as a starting point and these values (for a 3600 RPM machine) are used as the default alert thresholds by the vibration transmitter.

These levels were devised for periodic data collection with a portable vibration analyzer and are set relatively low. For frequent automated monitoring, such as that offered by the CSI 9420, the levels can be increased for most balance of plant equipment running between 900 and 4000 RPM. You can use the "rule of tens" as a simple but effective approach to monitoring PeakVue on most rolling element bearing machines. Using this guideline, we can assume the following:

Level	Interpretation
0	Machine is in good condition
10	Some problem is developing on the machine
20	The problem has become serious
40	Problem is critical

Note

The appropriate alerts for a given machine will be a function of its design, service, and turning speed.

Utilizing the embedded PeakVue technology, the CSI 9420 identified developing problems at a couple of test sites during early field trials. In both cases, the problem was not visible with conventional low-frequency analysis. The following examples provide sample data from one of the sites. Notice in the example that the velocity measurement is indicating less than 0.1 in/s. The PeakVue trend, however, indicates high-frequency vibration that is regularly in excess of 6 g's.

Figure 5-5: Example 1: 4600 HP fan motor - OH (Overall)

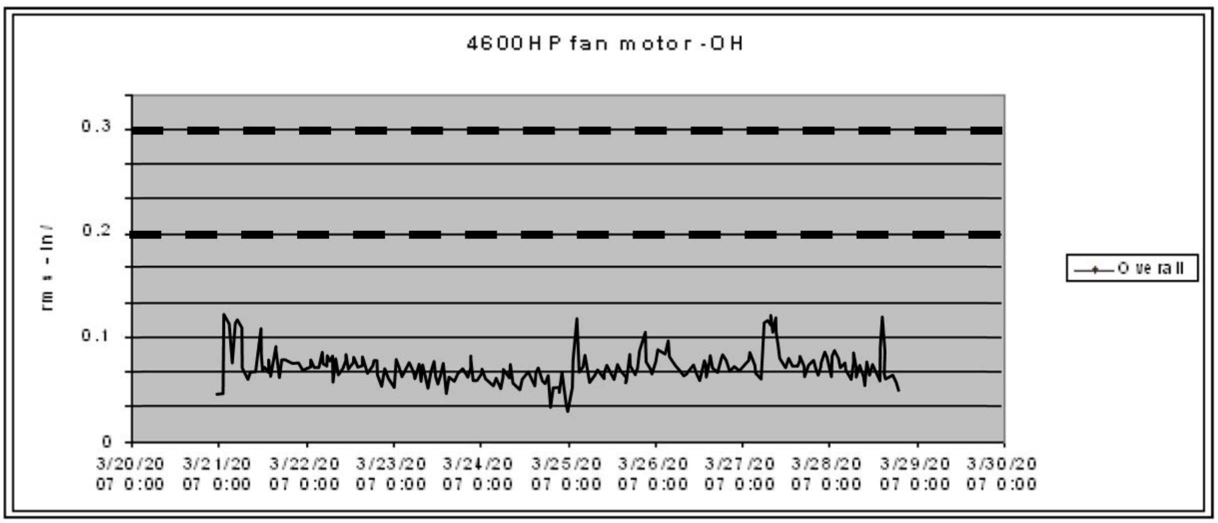
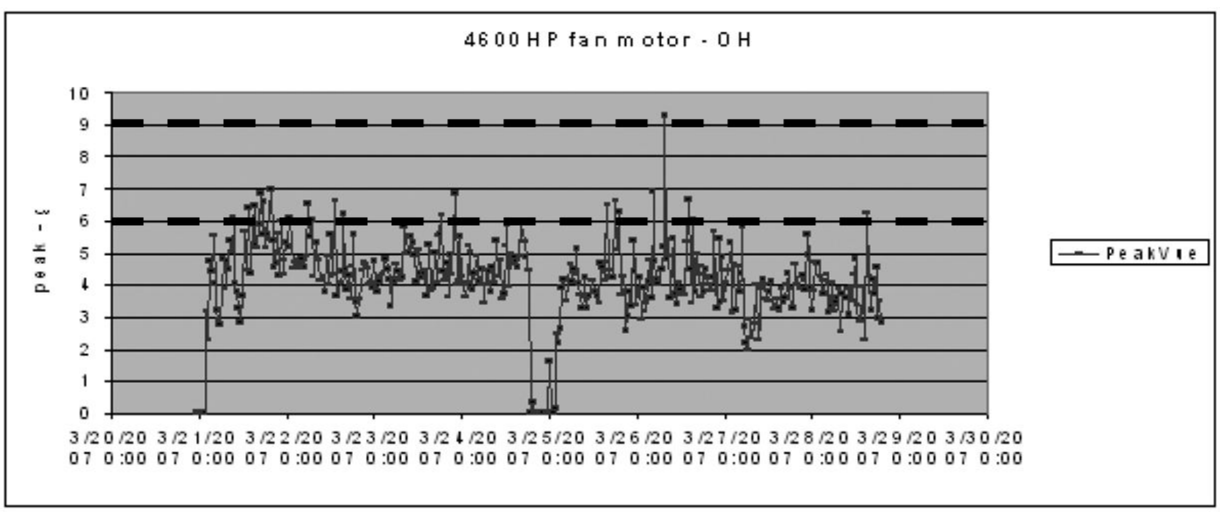


Figure 5-6: Example 2: 4600 fan motor - OH (PeakVue)



The defective bearing was removed and *Figure 5-7* shows the developing problem that was the source of the impacting. After replacing the bearing, the PeakVue vibration is significantly reduced, as shown in *Figure 5-8*, indicating that the problem has been resolved.

Figure 5-7: Defective bearing

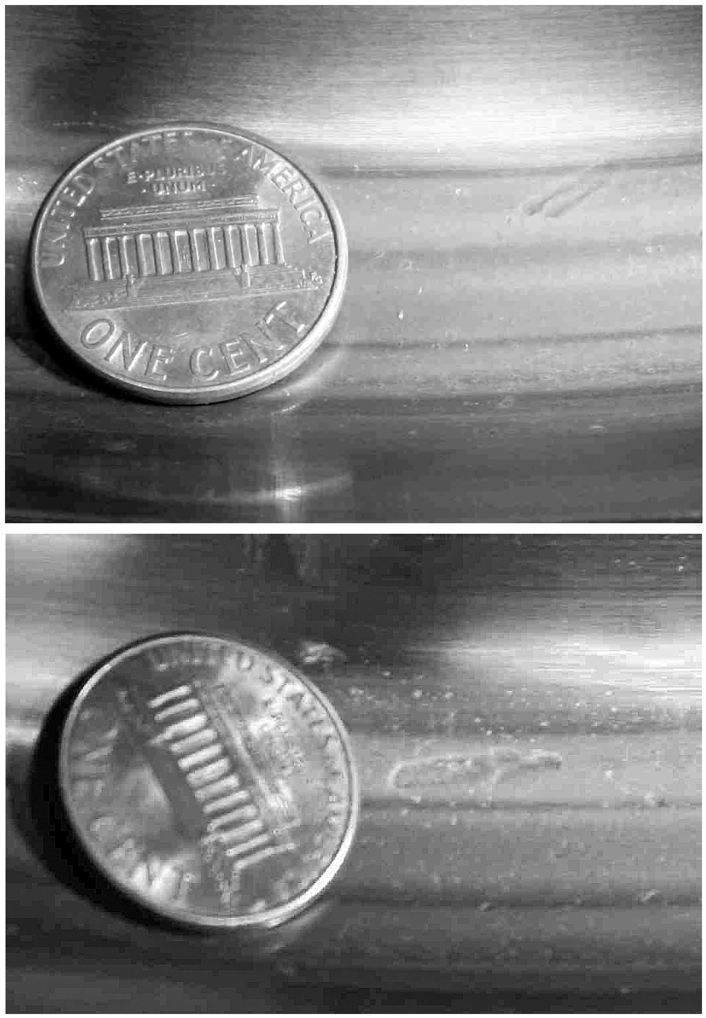
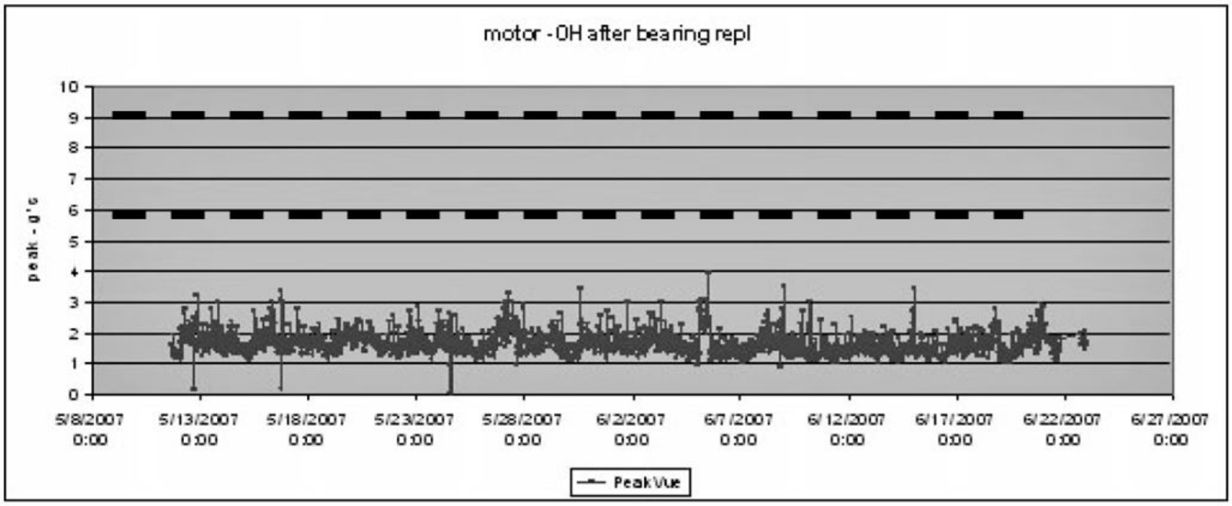


Figure 5-8: Motor - OH after the bearing is replaced (PeakVue)



5.3 Temperature

The levels at which to set temperature alerts depend on a number of factors including the specific process, the operating environment, and the characteristics of the equipment being monitored. This section provides some generic guidelines, given some knowledge of the variables involved, for setting the thresholds for your specific CSI 9420 installation. However, the generic methodologies described here are no substitute for first-hand knowledge of your plant. If, for example, you know that you have problems when a temperature exceeds a particular value, then set your thresholds accordingly rather than following these generic guidelines.

In general, the best way to detect a developing fault related to temperature is to look for an increase in temperature, relative to ambient, over time. This implies that, for reliable alerting, the thresholds should change as ambient temperature changes. In practice, this can be difficult to do because it requires the operator to constantly monitor the ambient temperature and adjust the alert levels accordingly. It is customary, therefore, to pick an "average" ambient temperature (that is generally seasonal for outdoor installations) and choose fixed thresholds based on this average. Also, there are issues with this methodology (such that it does not work well) in areas with large variations in ambient temperature.

You can select thresholds based on some absolute temperature limit. In practice, this is much easier to maintain but is not as effective at detecting early failures as relative monitoring.

5.3.1 Relative temperature monitoring

The recommended generic guidelines for setting the thresholds based on the relative change are:

T_{Advise} = 10°C increase

$T_{Maintenance}$ = 15°C increase

T_{Failed} = 20°C increase

Assuming that the ambient temperature is 25°C, when operating at steady-state, you have determined that the normal temperature at this point on your equipment is 55°C. Your "baseline" relative difference is 30°C. Using these guidelines, you should choose the Advise, Maintenance, and Failed levels for a difference of 40°C, 45°C, and 50°C, respectively. Assuming the ambient temperature is constant at 25°C, this means the thresholds become 65°C, 70°C, and 75°C for Advise, Maintenance, and Failed, respectively. Then, as the ambient temperature changes, the thresholds should be changed accordingly (e.g., a 5°C increase in ambient temperature raises the alert thresholds by 5°C).

5.3.2 Absolute temperature monitoring

For monitoring a driven component (such as a pump or fan), there are no generic rules to determine the default levels without some prior knowledge of the steady-state baseline (good) value. In general, the Advise level should be set about 10°C to 20°C above this baseline, with the Maintenance level about 10°C above Advise and the Failed level about 10°C above Maintenance.

There are equations that define the suggested generic thresholds for monitoring motor (driver) temperature. These are based on characteristics of the motor as well as knowledge of the ambient temperature.

The first step is to determine the estimated winding temperature, which is dependent on the following variables:

- Insulation type
- Motor type
- Ambient temperature
- Altitude

The estimated winding temperature, T_W, is the rise in temperature, T_{rise}, for the appropriate type of motor adjusted for high ambient temperature (T_a) effects.

T_{rise}=

- 65°C + serv_fact_temp; for class A insulation
- 85°C + serv_fact_temp; for class B insulation
- 110°C + serv_fact_temp; for class F insulation
- 130°C + serv_fact_temp; for class H insulation
- 150°C + serv_fact_temp; for class N insulation

where serv_fact_temp =

- 5 for service factor of 1.15 or greater
- -5 for either open or totally enclosed fan cooled (TEFC) motors, and service factor of 1.0
- 0 for either totally enclosed non-ventilated (TENV) motors or motors with encapsulated windings, and service factor of 1.0

If elevation > 3300 ft (1000m), then:

$T_{rise} = T_{rise}$ {1-[(altitude (units of ft) - 3300)/33,000]}

If T_a is less than or equal to 40°C (or unknown), then:

$T_w = T_{rise} + 40°C$

If $T_a > 40°C$, then:

$T_w = T_{rise} + 40°C - (Ta - 40°C)$

If T_a is unavailable, assume that T_a is less than 40°C.

Next, calculate the generic alert thresholds based on the estimated winding temperature, T_W.

T_{f_fault} = Fault level alarm temperature (°C) of the motor skin (frame)

$T_{f\_maintenance}$ = Maintenance level alarm temperature (°C) of the motor skin

$T_{f\_advisory}$ = Advisory level alarm temperature (°C) of the motor skin

Alarm levels

For open drip proof (ODP) motors:

$T_{f\_fault} = 35.5366*Ln(T_w) - 91.1571$

For totally enclosed motors:

$T_{f\_fault} = 37.2028*Ln(T_w) - 102.8868$

For all motors:

$T_{f\_maintenance} = T_{f\_fault} - 10°C$

$T_{f\_advisory} = T_{f\_fault} - 20°C$

Error indication and steady-state determination

- Do not use any data readings collected within 30 seconds of motor start up.
- Check for error indications:
  - If $T_f > 150°C$, the sensor is shorted.
  - If $T_f < -40°C$, the sensor is open or the wire is broken.
- Steady-state is said to have been reached when, over any 5-minute time interval, the maximum variation in temperature is less than 2°F.

6 Accelerometer EMI and RFI considerations

The CSI 9420 uses an accelerometer to measure vibration. The process involves a piezoelectric element, which produces a time-waveform with voltage amplitude proportional to acceleration. The input bandwidth of the measurement is approximately 20 kHz. This waveform is then digitized and analyzed within the CSI 9420 to produce the desired vibration parameters.

Due to the high-frequency nature of the measurement, it is inherently susceptible to electromagnetic interference (EMI) and radio frequency interference (RFI), which can cause distortions in the measurement. This section discusses ways to mitigate, eliminate, or at least significantly reduce these effects.

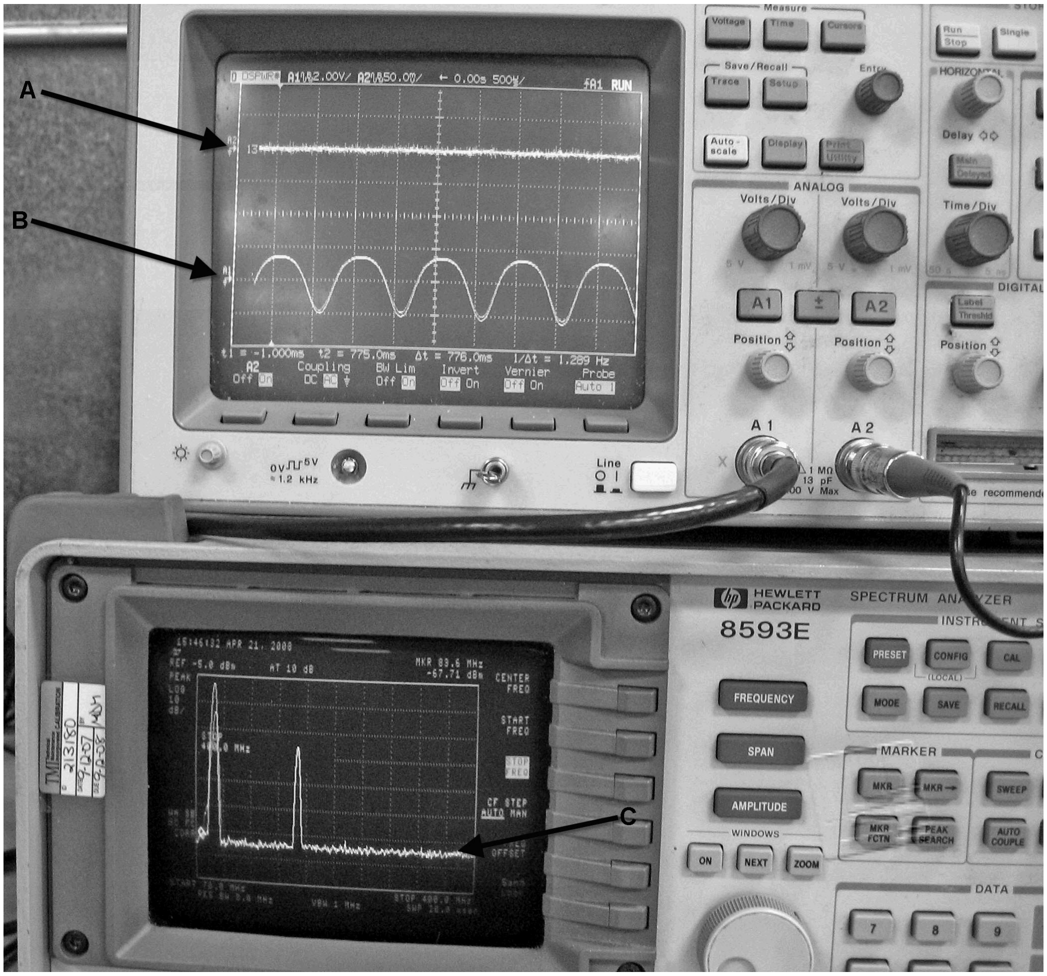
Note

The mitigating strategies discussed here only apply to the measurement of vibration, as an accelerometer only measures vibration. If you use a sensor that has both vibration and embedded temperature capabilities, these strategies will only work for the vibration measurement part of the sensor.

The primary source of the susceptibility is the cable between the accelerometer and the transmitter housing. Longer cable lengths act like antennas at high frequencies, and as such, receive radio frequency (RF) energy and transfer it to the measurement electronics, which is indistinguishable from the signals it is specifically designed to detect.

Figure 6-1 shows two lab instruments displaying accelerometer signals with and without interference. The one on top is an oscilloscope, which displays signals (in volts) in the time domain (signal amplitude as a function of time). The one at the bottom is a spectrum analyzer, which displays signals (in volts) in the frequency domain (signal amplitude as a function of frequency).

Figure 6-1: Accelerometer signal with and without interference



A. *Signal measured with no RFI effect.*

B. *Signal in the presence of interference on a completely unmitigated accelerometer.*

C. *Frequency spectrum representation of the signal with interference.*

6.1 Mitigate interference

The following are four basic things you can do to reduce EMI and RFI on measurements:

- Use a shorter cable, if possible. For more details, see *Section 6.1.1*.

  Note
  The leads on the sensor cables, as delivered, are specially prepared for ease of installation. Before attempting to cut the cables, be aware that cutting cables is associated with significant additional rework to correctly prepare the sensor for installation.

- Run the cable through a conductive conduit, grounded at both ends. For more details, see *Section 6.1.2*.
- Install ferrites on the cable. For more details, see *Section 6.1.3*.
- Avoid running the cable such that it matches the polarization of expected interference sources. For more details, see *Section 6.1.4*.

Note
The best approach in mitigating interference also depends on the application and on local installation codes.

6.1.1 Use shorter cable lengths

Accelerometers are available with standard cable lengths of 10 meters (30 ft) and 30 meters (100 ft) . Because the cable is the most susceptible component of the measurement system, the best way to avoid the problem of EMI/RFI is to use shorter cable lengths.

When planning the installation, keep in mind that shorter cable lengths significantly improve immunity to EMI/RFI. Try to keep cable runs as short as reasonably possible. Even 3-meter cables have some susceptibility in the presence of high-intensity RF fields; it is strongly recommended that you consider other mitigating strategies discussed in this section even if you are using shorter cables.

Note
The leads on the sensor cables, as delivered, are specially prepared for ease of installation. Before attempting to cut the cables, be aware that cutting cables is associated with significant additional rework to correctly prepare the sensor for installation.

6.1.2 Use a conductive conduit

Running the cable through a conductive conduit provides additional shielding and increases immunity to EMI/RFI. For best results, the conduit should be grounded at both ends. As a general rule, the conduit is automatically grounded at the transmitter because it screws into the transmitter housing, which should be grounded. Ensuring the conduit is also grounded at the accelerometer end (and at points along the conduit run) reduces coupling of the interfering energy into the cable and propagating it along the cable into the accelerometer.

Figure 6-2 shows how to run the accelerometer through a conduit that is grounded on both ends. As a general rule, the transmitter housing itself is grounded through the base where it is mounted. Since the conduit is electrically connected to the transmitter housing, this effectively grounds the conduit at the transmitter end.

Grounding the conduit at the accelerometer end as well significantly reduces the possibility that energy due to EMI/RFI can be coupled into the accelerometer cable. When employing this method, minimize the length of cable that is outside of the conduit by running the conduit as close as reasonably possible to the point where the accelerometer is mounted to the equipment being monitored.

Figure 6-2: Grounded conduit

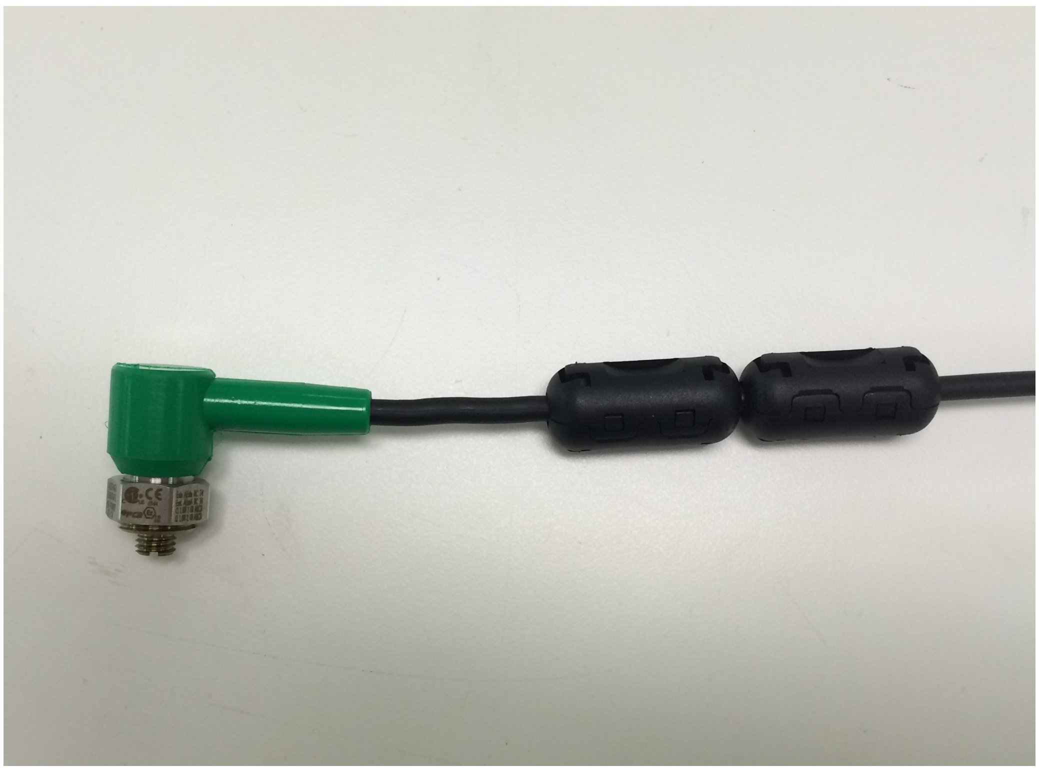
6.1.3 Install ferrites

Note

The accelerometers are shipped with ferrites installed at the accelerometer end. To maintain the optimum performance of the accelerometer, do not remove the ferrites.

To meet the stated performance criteria, the standard accelerometer cable has two (2) ferrites installed. These are Steward ferrites (P/N 28B0355-000), with each providing 205 Ω of reactance at 100 MHz.

Figure 6-3: Standard accelerometer cable with ferrites installed (as shipped from the factory)



The armor-jacketed accelerometer cable has one ferrite installed. It is a Steward ferrite (P/N 28B0672-000), which provides 245 Ω of reactance at 100 MHz.

Figure 6-4: Armor-jacketed accelerometer cable with ferrite installed (as shipped from the factory)

If your cables require additional immunity after accelerometer installation is complete and accelerometer cables have been run through a conduit (if applicable), you can place additional ferrites on the other end of the cable.

Note

The performance of the accelerometer is not maintained beyond a 3-m (10-ft) cable-length unless you install additional ferrites.

All low-power sensors for use with the CSI 9420 are shipped with additional ferrites if their cable lengths exceed 3 meters. To ensure compliance with the CE directive, if the cable length exceeds 3 meters, all standard sensor configurations (1 accelerometer, 1 accelerometer with embedded temperature, or 2 accelerometers) require ferrite installation at the site.

These ferrites are not installed on the accelerometer cable at the factory because they must be installed on the transmitter end of the cable, and the cables are typically cut to length at the site. To maintain compliance with the CE directive, sensors with cables longer than 3 meters must have 3 additional ferrites installed. You do not need to install the additional ferrites if the cable length is less than 3 meters.

From a compliance perspective, you do not need to install the ferrites if the cable is in a ferromagnetic conduit (such as galvanized steel) because this type of conduit provides additional shielding. Note that the conduit entry of the device is ½ inch NPT. If you install ferrites with a conduit, you will need a wider conduit (¾ inch NPT or M20) to accommodate the ferrites and an adapter is required at the conduit entry of the device.

The ferrites provided with the sensors that have standard (polyurethane) cables are Fair-Rite P/N 0431173951. These ferrites simply snap onto the cable near the point where the cable enters the transmitter housing. You can also use wire ties and/or heat-shrink with these ferrites.

The ferrites provided with the sensors that have armor-jacketed cables are Fair-Rite P/N 2631665702. These slide onto the cable and must have wire-ties and/or heat-shrink, or some similar mechanism, to hold them in place.

Figure 6-5: Transmitter, accelerometer with standard cable, and ferrites (pre-installation)

Figure 6-6: Armor-jacketed cable and ferrites (pre-installation)

Install ferrites on a standard cable

1. Make standard connections to the CSI 9420 terminal block and grounding screw.
2. Snap the first of three attenuator ferrites (MHM-94985) at the location on the cable approximately 1 in. from the point where the cable enters the gland.
3. Snap the second ferrite onto the cable adjacent to the first; then snap the remaining ferrite adjacent to the second.

Note

Apply adequate force in the ferrites' closures so that the keeper latches fully engage. This ensures that the ferrites remain securely fastened to the cable.

Figure 6-7: Ferrites installed on a standard cable

Install ferrites on an armor-jacketed cable

1. Make standard connections to the CSI 9420 terminal block and grounding screw.
2. Slide the first of the three ferrites at the location on the cable approximately 1 in. from the point where the cable enters the gland.
3. Secure the ferrite using a wire tie, heat-shrink, or any other method approved for your location.
4. Slide the second and third ferrites onto the cable adjacent to the first, and secure them in place with a wire tie or heat-shrink.

Figure 6-8: Ferrites installed on an armor-jacketed cable

You need an additional ferrite for devices that use external DC supply. This ferrite is included with the transmitter if you order the external power option.

Figure 6-9: Transmitter using an external power option with ferrites installed

This is a snap-on ferrite. Depending on the size of the wire used, you might need to secure the ferrite in place.

The ferrite in this example is Fair-Rite P/N 0431164281, which has a reactance that ranges from 28 Ω at 1 MHz to 310 Ω at 100 MHz and 240 Ω at 250 MHz. It supports a maximum cable diameter of 0.260 inch (6.6 mm).

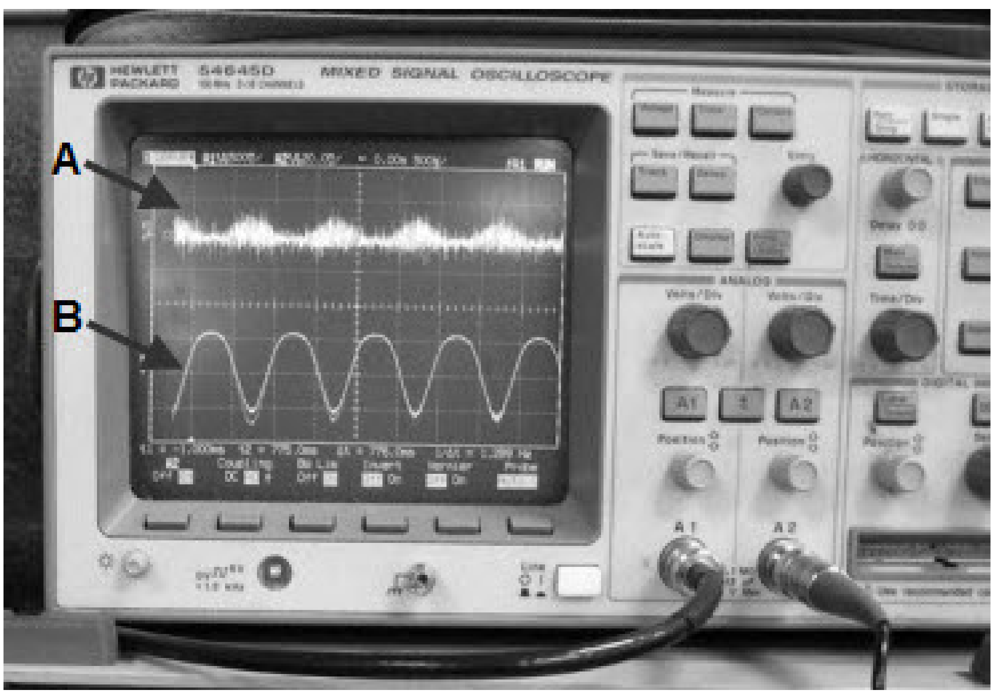
Effect of ferrites on interference

Figure 6-10 compares two accelerometers in the presence of a high-intensity RF field (10 V/m). The oscilloscope is the time-domain representation of the signals.

The upper trace (A) is a standard (non-armor-jacketed) 3-meter cable, without conduit, with polarization matching that of the interference field, and with two ferrites installed at the accelerometer end of the cable. The resulting interference is about 10 mV peak-to-peak, which is equivalent to a perturbation of about 0.2 g's peak to the acceleration measurement.

The lower trace (B) is a 3-meter cable of the same type, without conduit, with polarization matching that of the interference field. In this case there are no ferrites installed, and the resulting interference is about 1.2 V peak-to-peak, which is equivalent to a perturbation of about 24 g's peak to the acceleration measurement.

Figure 6-10: Accelerometer signals in the presence of high-intensity interference with and without mitigation*



A. *With two ferrites installed*
B. *Without ferrites installed*

**Scale is not the same for A and B in this graph.*

Figure 6-10 also shows that ferrites provide a huge amount of RFI suppression and are needed to maintain measurement integrity in the presence of strong electromagnetic interference. Do not remove the ferrites installed on the accelerometer cables that are shipped from the factory, even if you mitigate interference using other methods.

6.1.4 Reduce polarized interference

The maximum coupling onto the cable occurs when the polarization of the interfering signal matches the cable run. In most cases, intermittent interference sources, such as handheld two-way radios or tablet computers, are naturally vertically polarized because of the way we hold these items during normal usage. As a result, installations with long vertical runs of cable are more susceptible to EMI/RFI than horizontal runs of similar length.

Figure 6-11 illustrates how to install cables to improve immunity against vertically polarized interference, and *Figure 6-12* illustrates cable installations that increase susceptibility to vertically polarized interference.

Figure 6-11: RFI source cross-polarized with long cable run (minimum interference)

Figure 6-12: RFI source polarization coincident with long cable run (maximum interference)

6.1.5 Summary

To maximize immunity to EMI/RFI, consider the following when planning the installation of the CSI 9420 and its accelerometers:

Required

- Use ferrites to attenuate interference that couples into the accelerometer cable.
- Ensure the installation conforms with all local codes and regulations.

Best practice

- Use a shorter cable, if possible.
- Consider running accelerometer cables in conductive conduit, grounded on both ends.
- Avoid vertical cable runs because this geometry increases susceptibility to vertically polarized causes of interference.

Appendix A Specifications and reference data

Topics covered in this appendix:

- *Functional specifications*
- *Physical specifications*
- *Performance specifications*
- *Radio specifications*
- *Low-power sensors (special order and standard)*
- *Dimensional drawings*
- *Sensor mounting diagrams*

A.1 Functional specifications

Input	Supports 1 or 2 accelerometers, or 1 accelerometer with an embedded temperature sensor. See *Section A.5* for more information.
Output	Wireless-enabled, linear with temperature or input.
Local display	The optional five-digit integral LCD can display engineering units g's, m/s^2, in/s, mm/s, °F, and °C. It can also display updates at a transmit rate of up to once per minute.
Humidity limits	0–95% relative humidity
Transmit rate	User-selectable, 60 seconds to 1 hour for the 2.4 GHz CSI 9420.

Measurement

Range

RMS velocity (frequency dependent): 0.008 in/s to >4.35 in/s (0.20 mm/s to >110.5 mm/s)

PeakVue: 0.02 g to 80 g (0.2 m/s^2 to 785 m/s^2)

PeakVue details: 51.2 kHz sampling rate, 4096 samples/block, 1000 Hz high pass filter

Accuracy

For vibration over stated frequency response (at room temperature)

RMS velocity:

- +/- 5% from 10 Hz to 800 Hz
- (3.0 dB) from 2 Hz to 1000 Hz

PeakVue:

- +/- 5% from 2000 Hz to 10 kHz
- (3.0 dB) from 1000 Hz to 25 kHz

Temperature

- +/- 2°C

Sensor variability (vibration)

- Temperature coefficient: 0.1% per °F; 0.18% per °C (2 dB, worst case)
- EMI/transient susceptibility (2.4 GHz only): +/- 15% (1.2 dB) under worst-case interference conditions (per EN 61326)
- 3 dB up to 10 kHz; 10 dB up to 25 kHz

Sensor variability (temperature)

EMI/transient susceptibility of the temperature measurement is unspecified, since this is not the primary purpose of the device. Testing has demonstrated that high-intensity RF fields have the potential to render the temperature measurement meaningless.

Measurement precision

Measurement precision refers to the variability of the same measurement in a fixed operating environment under steady-state conditions. For vibration, this value is obtained with statistical measurements with 1 g-peak (9.81 m/s^2) input excitation at a frequency of 100 Hz. For temperature, this value is obtained with statistical measurements at room temperature.

- Vibration: 0.2 dB
- Temperature: +/- 2°C

A.2 Physical specifications

Electrical connections/power module

Smart Power Module

- Replaceable, non-rechargeable, intrinsically safe lithium-thionyl chloride power module pack with PBT enclosure
- 1.5–3-year power module life at reference conditions[1]
- 4 screw terminals for sensor connection

External DC power

- 10-28 VDC, 40 mA, 80 mA peak
- 22 gauge wire minimum

Field Communicator connections

- Communication terminals
- Clips permanently attached to the terminal block

Construction materials

- Enclosure housing – Low-copper aluminum[2]
- Paint – Polyurethane
- Cover O-ring – Buna-N
- Terminal block and power module pack – PBT
- Antenna – PBT/PC integrated omnidirectional antenna

Mounting

Transmitter mounting requires mounting brackets. See the *Section A.6* for more information.

Weight

CSI 9420 without LCD – 4.6 lb (2 kg)

CSI 9420 with M5 LCD – 4.7 lb (2.1 kg)

Enclosure ratings

Housing is NEMA 4X and IP66 with approved cable glands

(1) Reference conditions are 70 °F (21 °C), two accelerometers with a transmit rate of once every 60 minutes, and routing data for three additional network devices, LCD disabled, no time-based collection of energy band.

(2) The housing is also available in non-polished stainless steel. Contact an Emerson sales representative for more information.

A.3 Performance specifications

Temperature Limits

The transmitter will operate within specifications for ambient temperatures between −40°F and 185°F (−40°C and 85°C).

Table A-1: Temperature limits

CSI 9420	Operating limit	Storage limit
With LCD display	−4°F to 175°F −20°C to 80°C	−40°F to 185°F −40°C to 85°C
Without LCD display	−40°F to 185°F −40°C to 85°C	−40°F to 185°F −40°C to 85°C

Electromagnetic compatibility (EMC)

The 2.4 GHz CSI 9420 meets all requirements listed under IEC 61326:2006.

A.4 Radio specifications

Parameter	Min	Typical	Max	Units	Comments
Operating frequency	2.4000	-	2.4835	GHz	-
Number of channels	-	15	-	-	-
Channel separation	-	5	-	MHz	-
Occupied channel bandwidth	-	2.7	-	MHz	at -20 dBc
Frequency accuracy	-50	-	+50	kHz	-
Modulation	-	-	-	-	IEEE 802.15.4 DSSS
Raw data rate	-	250	-	kps	-
Received operating maximum input level	-	0	-	dBM	-
Receiver sensitivity	-	-92.5	-	dBM	At 50% PER V_{DD} = V, 25°C
	-	-90	-	dBM	At 1% PER, V_{DD} = 3 V, 25°C (inferred from 50% PER measurement
Output power, conducted	-	+8	-	dBM	V_{DD} = 3 V, 25°C Long Range Antenna
	-	+12.5	-	dBM	V_{DD} = 3 V, 25°C Extended Range Antenna

A.5 Low-power sensors (special order and standard)

Table A-2: Special order models

Part number	Color code	Cable length (ft)	Cable type	Sensor range
Accelerometer				
A0394RI	Green	10	Polyurethane	0.02 g to 80 g from 1 kHz to 20 kHz 0.01 in/s to 4.35 in/s at 1 kHz
A0394RI-2		50		
A0394RI-3		75		
A0394RA		10	Armor	
A0394RA-2		50		
A0394RA-3		75		
A0394RAC		10	Armor w/ Teflon coating	
A0394RAC-1		30		
A0394RAC-2		50		
A0394RAC-3		75		
A0394RAC-4		100		
Dual output sensor (Accelerometer and temperature)				
A0394DI	Blue	10	Polyurethane	0.02 g to 80 g from 1 kHz to 20 kHz 0.01 in/s to 4.35 in/s at 1 kHz -40°C to 125°C
A0394DI-1		30		
A0394DI-2		50		
A0394DI-3		75		
A0394DI-4		100		
A0394DA		10	Armor	
A0394DA-1		30		
A0394DA-2		50		
A0394DA-3		75		
A0394DA-4		100		
A0394DAC		10	Armor w/ Teflon coating	
A0394DAC-1		30		
A0394DAC-2		50		
A0394DAC-3		75		
A0394DAC-4		100		

Table A-3: Standard order models

Part number	Color code	Cable length (ft)	Cable type	Sensor range
Accelerometer				
A0394RI-1	Green	30	Polyurethane	0.02 g to 80 g from 1 kHz to 20 kHz 0.01 in/s to 4.35 in/s at 1 kHz
A0394RI-4		100		
A0394RA-1		30	Armor	
A0394RA-4		100		

A.6 Dimensional drawings

Sensors are specified separately.

Dimensions are in inches (millimeters).

Figure A-1: CSI 9420 with sensor and mounting brackets

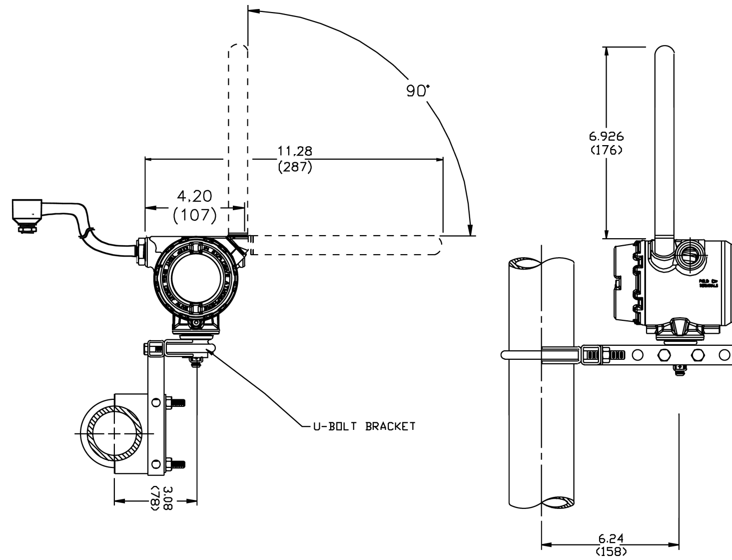
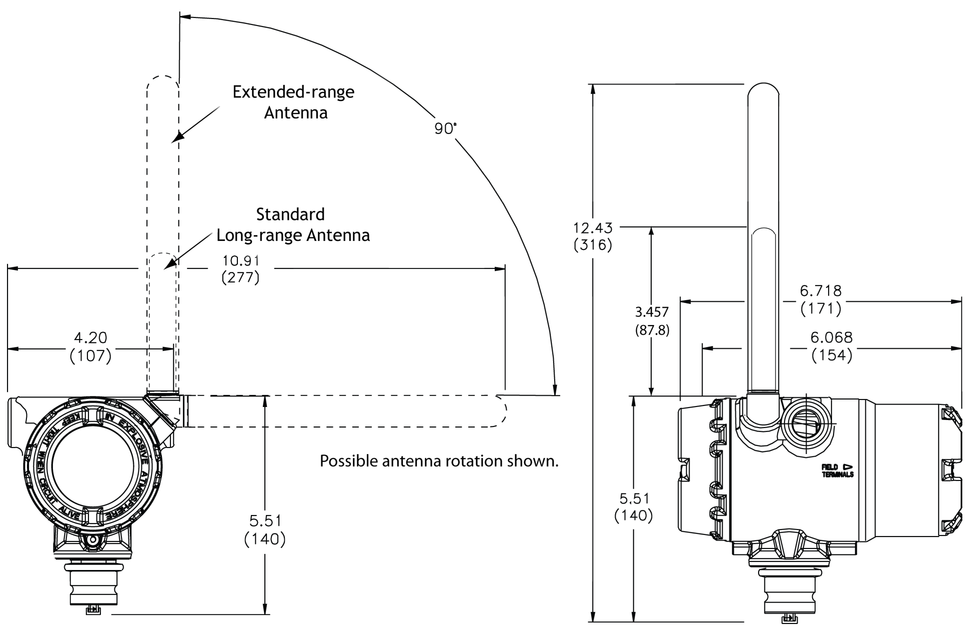


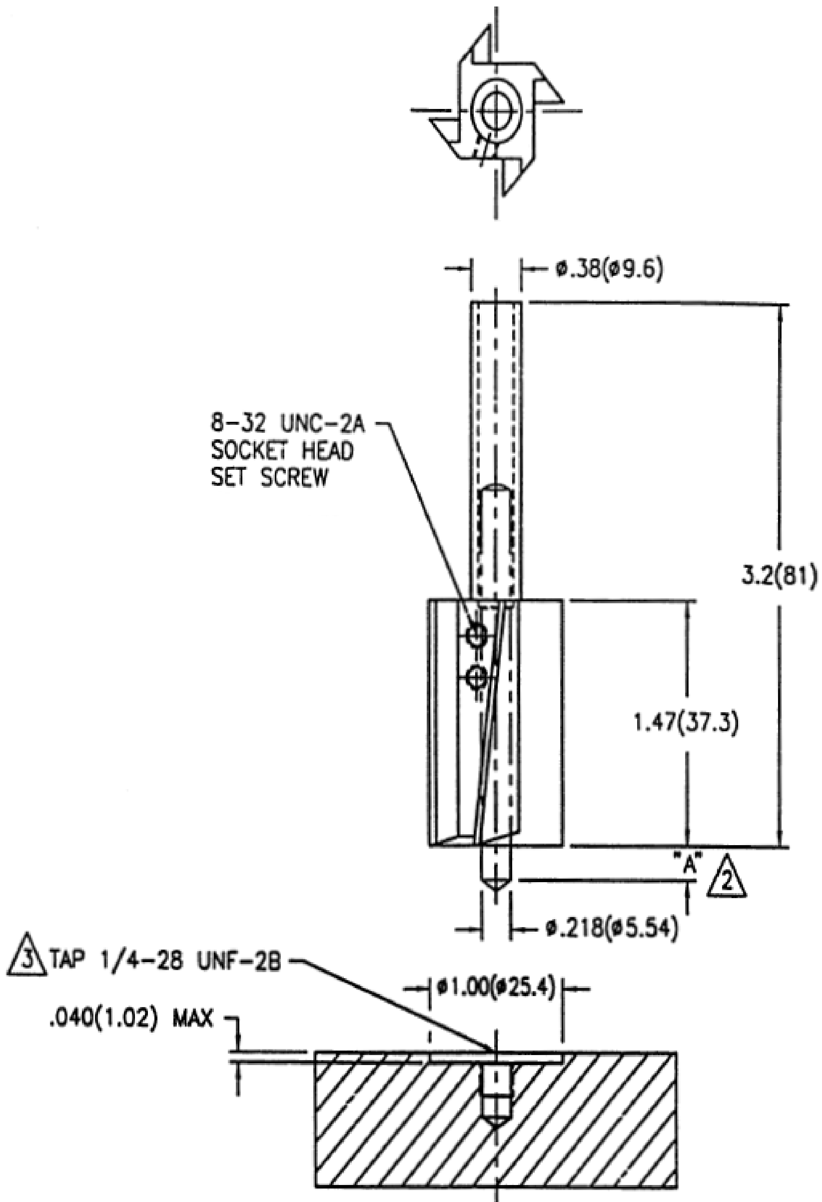
Figure A-2: CSI 9420 with long-range and extended antennas



A.7 Sensor mounting diagrams

Figure A-3: Milling process

This spot facing should create a uniform seat.



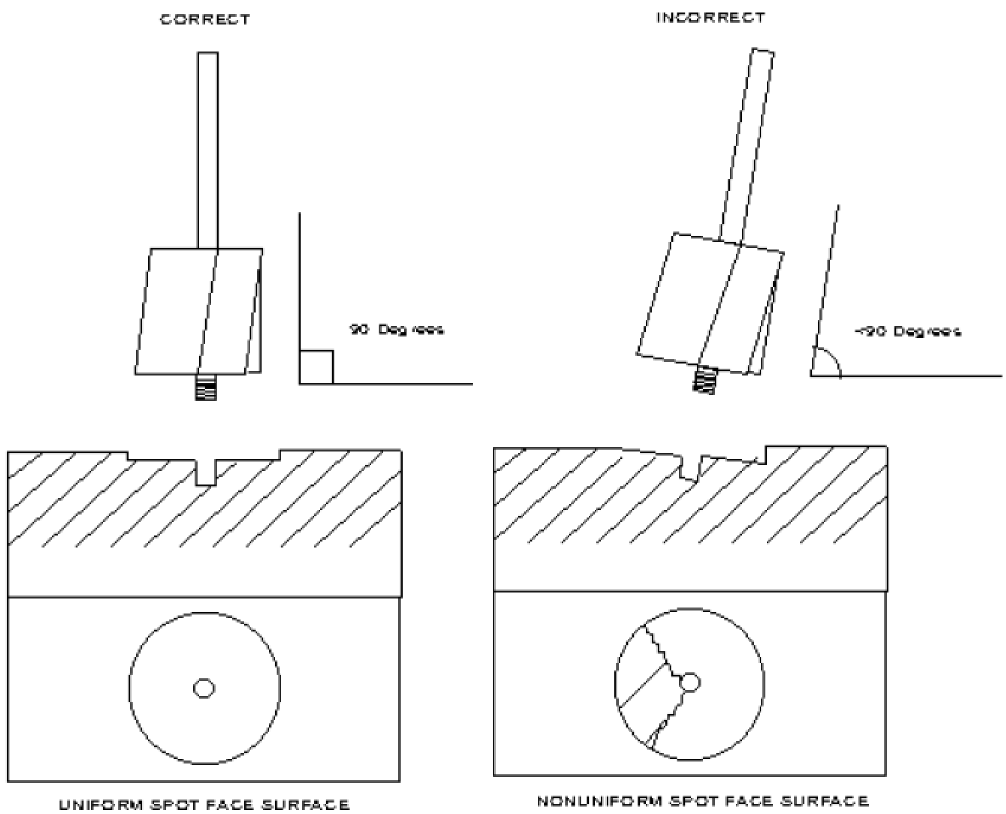
3 TAP FOR HARD STEEL = .145 ↧, FOR CASTINGS = .255 ↧

2 FOR HARD STEEL DIM "A" = .215(5.46), FOR CASTINGS DIM "A" = .325(8.26).

1.) USE VARIABLE SPEED 1/2" DRILL @ 200 RPM.

Figure A-3 shows specifications for drilling and spot face grinding when mounting accelerometers using the stud mount method, and *Figure A-4* shows the correct and incorrect milling process.

Figure A-4: Correct and incorrect milling

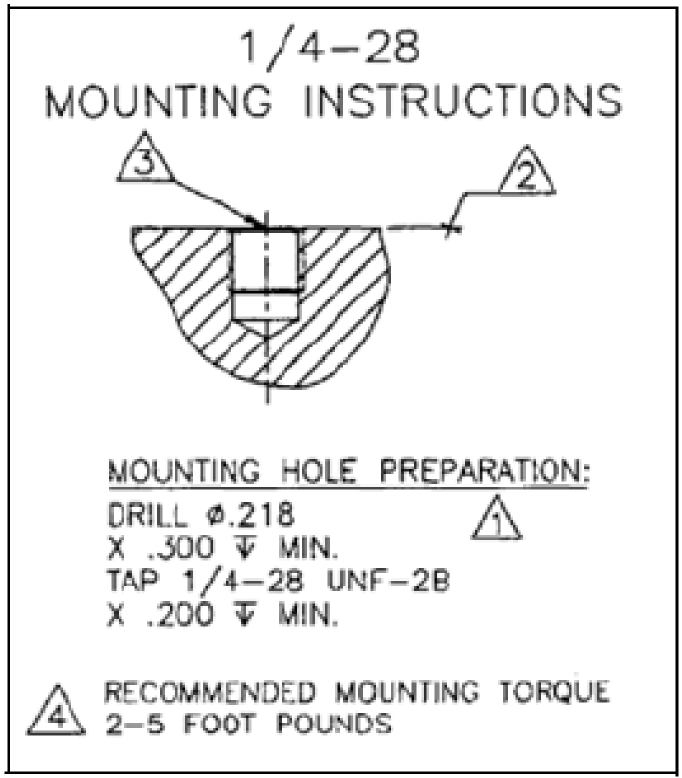


Note

Properly align the drill so that the tapped hole is perpendicular to the mounting surface.

Figure A-5 shows the specifications for drilling, tapping a pilot hole, and torqueing the mounting stud when mounting the sensor.

Figure A-5: Accelerometer mounting



Appendix B
Product certifications

Topics covered in this appendix:

- *Approved manufacturing location*
- *Wireless certifications*
- *Hazardous locations certificates*

Note

For specific device certifications, always refer to the product nameplate and markings on the device.

B.1 Approved manufacturing location

Emerson Process Management - MHM, Knoxville, Tennessee, USA

B.2 Wireless certifications

Telecommunications compliance

All wireless devices require certification to ensure that they adhere to regulations regarding the use of the RF spectrum. Nearly every country requires this type of product certification. Emerson works with governmental agencies around the world to supply fully compliant products and remove the risk of violating country directives or laws governing wireless device usage.

Radio and Telecommunications Terminal Equipment Directive (R&TTE)(1999/5/EC)

Emerson Process Management complies with the R&TTE Directive.

FCC and IC approvals

This device complies with Part 15 of the FCC Rules. Operation is subject to the following conditions:

- This device may not cause harmful interference.
- This device must accept any interference received, including interference that may cause undesired operation.
- This device must be installed to ensure a minimum antenna separation distance of 20 cm from all persons.

Telecommunication compliance

2.4 GHz CSI 9420

FCC ID: LW2RM2510

IC ID: 2731A-RM2510

Ordinary location certification (CSA)

As standard, the transmitter has been examined and tested to determine that the design meets basic electrical, mechanical, and fire protection requirements by CSA, a nationally recognized testing laboratory (NRTL) as accredited by the Federal Occupational Safety and Health Administration (OSHA).

CE mark

The 2.4 GHz version of the device has been tested and complies with all relevant directives required for CE marking.

Country	Restriction
Bulgaria	General authorization required for outdoor use and public service.
Italy	If used outside of own premises, general authorization is required.
Norway	May be restricted in the geographical area within a radius of 10 km from the center of Ny-Alesund.
Romania	Use on a secondary basis. Individual license is required.

Electromagnetic Compatibility (EMC) (2004/108/EC)

All Models: EN 61326-1, 61326-2-3: 2006

Canadian Standards Association (CSA)

CAN/CSA-C22.2 No. 61010-1-04 - Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use, Part 1: General Requirements

ISA S82.02.01 2nd (IEC 61010-1 Mod) - Safety Standards for Electrical and Electronic Test, Measuring, Controlling and Related Equipment - General Requirements

UL 61010-1 2nd - Safety Requirements for Electrical Equipment for Measurements, Control, and Laboratory Use, Part 1: General Requirements

B.3 Hazardous locations certificates

The CSI 9420 carries multiple certificates for operation in hazardous locations. For a complete listing of specific approvals, please reference our website.

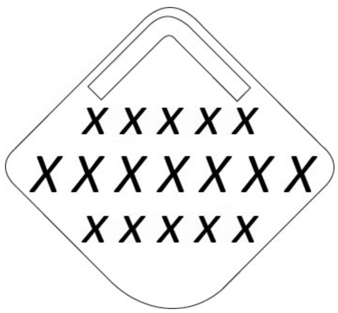
Note

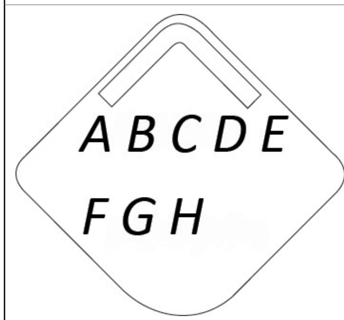
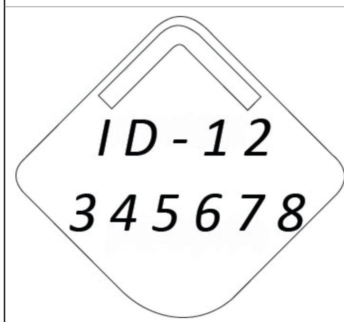
The markings that appear on the transmitter housing determine whether a device is suitable for operation in a specific hazardous location. This further requires that the transmitter is being operated in accordance with the installation drawings provided with the unit.

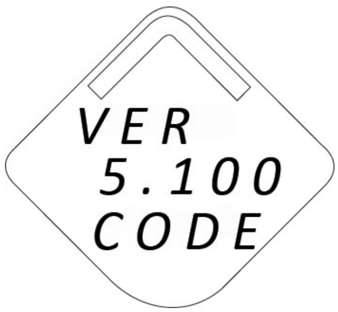
Appendix C
LCD screen messages

Startup screen sequence

These are the screens when the power module is first connected to the CSI 9420.

LCD screen	Meaning	Description
	All Segments On	Used to visually determine if there are any bad segments on the LCD.
	NIM Startup	The device is waiting for the radio to initialize. This takes approximately 15 seconds.
	Device Name	Used to determine the device name.

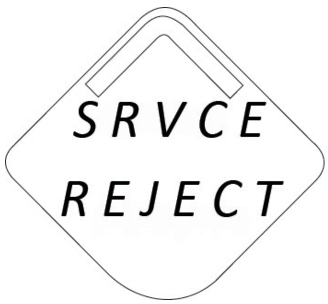
LCD screen	Meaning	Description
	Acquire Preparation	The device powers up the DSP and prepares for data acquisition.
	Acquire Data	The device is acquiring and processing data.
	Device Information Tag	8-character user entered tag.
	Device Identification	Device identifier that makes up the HART long address. The Smart Wireless Gateway may use this to help identify devices if no unique user tag is available.

LCD screen	Meaning	Description
	Network Identification	This ID tells the user what network the device can connect to, assuming the device has the correct Join Key.
	Version Code	Displays the firmware version of the device.

Joining and provisioning

These are the screens when the CSI 9420 is in the process of joining the network.

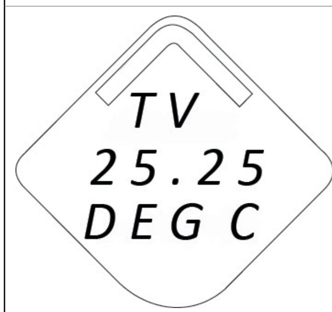
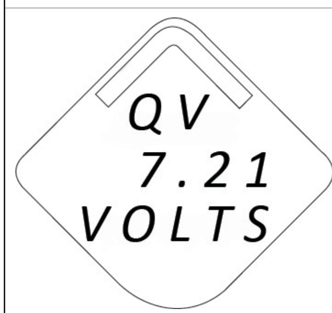
LCD screen	Meaning	Description
	Service Created	The request for network services has been granted to the device. Services must be obtained before the device can transfer data through the network.
	Service Delayed	The request for network services is pending.

LCD screen	Meaning	Description
	Set Service	The request for network services has been issued to the device.
	Service Rejected	The request for network services has been rejected by the network manager. Sufficient bandwidth may not currently be available.

Normal operating sequence

These are the screens displayed during normal operation.

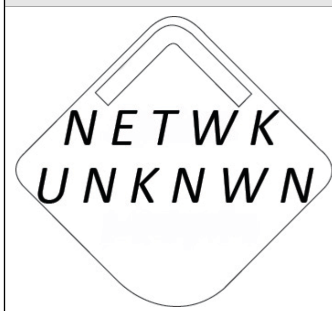
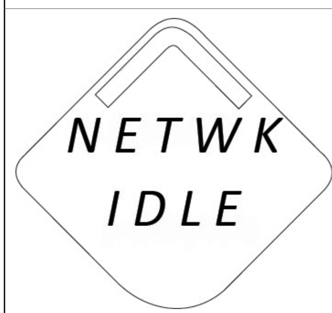
LCD screen	Meaning	Description
	Network Operational	The device is connected to both the network manager and the gateway. It is ready to send data.
	Acquire Preparation	The device powers up the DSP and prepares for data acquisition.

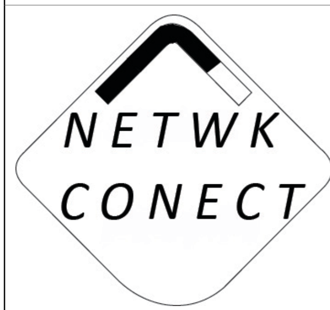
LCD screen	Meaning	Description
	Acquire Data	The device is acquiring and processing data.
	PV screen	Displays the overall velocity, PeakVue, temperature, sensor bias voltage, or power supply voltage depending on how the device is configured.
	SV screen	Displays the overall velocity, PeakVue, temperature, sensor bias voltage, or power supply voltage depending on how the device is configured.
	TV screen	Displays the overall velocity, PeakVue, temperature, sensor bias voltage, or power supply voltage depending on how the device is configured.
	QV screen	Displays the overall velocity, PeakVue, temperature, sensor bias voltage, or power supply voltage depending on how the device is configured.

LCD screen	Meaning	Description
	Data Publish	The device has started collecting new data and will publish it to the gateway when complete.
	Sleep	Shows how long the device sleeps between times it wakes up and collects/publishes data.

Network status screens

These screens display the network status of the CSI 9420.

LCD screen	Meaning	Description
	Network Unknown	The device has yet to retrieve information from the Smart Wireless Gateway and is still in the process of being activated.
	Network Idle	The device is in a low power idle state and it is not connected to the network.

LCD screen	Meaning	Description
	Network Search	The device is searching for a network.
	Network Negotiation	The device has detected a network and is attempting to establish connection.
	Network Connected	The device has joined the network and has established connection with the network manager.
	Network Operational	The device is connected to both the network manager and the gateway. It is ready to send data.

LCD screen	Meaning	Description
	Network Disconnected	The device is disconnected from the network.

Device diagnostic screens

These screens show the state of the CSI 9420.

LCD screen	Meaning	Description
	Device Failure	There is critical error which may prevent the device from operating correctly.
	Alert Present	At least one alert is present.
	Low Supply Voltage	The terminal voltage is below the recommended operating range. If the device is power module operated, the power module should be replaced. If the device is line-powered, the supply voltage should be increased.

LCD screen	Meaning	Description
	Supply Failure	The terminal voltage has reached a critical level. If the device is power module operated, the power module should be replaced. If the device is line-powered, the supply voltage should be increased.
	More Status Available	At least one device parameter is on alert.

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